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NOTES ON THE SYSTEMATIC ANATOMY OF STACKHOUSIA.

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Introduction.

For their "Anatomy of the Dicotyledons", Metcalfe and Chalk (1950) had to base their descriptions of certain families on published information without confirming the facts by direct observation. This was partly due to difficulty in obtaining material from overseas owing to war-time conditions. Furthermore, in certain families, all the available publications referred to investigations made many years ago. It is therefore proposed, from time to time, to publish additional notes on some of the families which have received no attention from anatomists in recent years.

One such family is the Stackhousiaceae which comprises a small group of plants, sometimes with woody rhizomes, that occurs in Australia, Tasmania, New Zealand and the Philippine Islands. The present investigation was prompted by the receipt of some well preserved material of *Stackhousia monogyna* Labill. from Miss W. M. Curtis who had collected it in Tasmania. Dr. R. Melville, of the Kew Herbarium, has very kindly checked the identity of this material. Additional observations were made on small pieces of stem and rhizome from specimens in the Kew Herbarium, viz. *S. pubescens* A. Rich. (Morrison 20025), *S. muricata* Lindl. (Hubbard 4964), *S. monogyna* Sieber. (Rodway 53) now regrouped by Dr. Melville as *S. linarifolia* A. Cunn., *S. huegelii* Endl. (Max Koch 1710), *S. viminea* Sm. (Max Koch 2974), and *S. brunonis* Benth. (Pritzel 92).

Previous Work

Solereder (1908) gives a brief account of the main anatomical features of the genus. This description is mainly based on the work of Pampanini and Bargagli-Petrucci (1905 and 1906) who have studied the family in some detail.

Methods

Transverse and longitudinal sections were cut with a sliding microtome at 25μ. Other specimens were sectioned by hand. Sections were stained in safranin and light green, phloroglucin and concentrated hydrochloric acid, dilute iodine solution, chlor-zinc-iodine, Sudan III. and ferric chloride.

Herbarium material was revived by boiling in water until all the air had been removed, followed by immersion in 95% alcohol for two or three days. Sections of this material were cleared in Eau de Javelle before staining in the usual way.

Tissue was macerated in nitric acid and potassium chlorate to facilitate a detailed study of the xylem histology and measurement of the constituent elements.

Anatomical Description

The following account of the anatomy of *Stackhousia* is based entirely on an examination of *S. monogyna* except where specific reference is made to other species.

Leaf.

Leaves usually dorsiventral (Fig. 1), but described by Pampanini and Bargagli-Petrucci (1906) as approximately centric in *S. brunonis* and isolateral in *S. aspericocca* Schuch. **Stomata** (Fig. 2) anomocytic (ranunculaceous), present on both surfaces, but more frequent in, and raised above, the lower epidermis. Cells of the upper **epidermis** polygonal (Fig. 2a), those of the lower epidermis more sinuous in outline (Fig. 2b). Outer walls of the epidermal cells thicker and covered by a continuous layer of **cuticle** with superficial striations. Thick-walled unicellular **hairs** mainly localised at the leaf margin (Fig. 3) and particularly well developed in *S. pubescens*. **Veins** lie in a plane separating 2–3 rows of palisade cells from loosely packed spongy mesophyll (Fig. 4). Cells more compactly arranged at the margins. **Sclerenchyma** absent throughout the leaf. **Vascular bundles** collateral, and surrounded by a sheath of large parenchyma cells. **Xylem** exhibiting the following characters. Long narrow vessel members. Spiral thickening in the protoxylem, and uniseriate rows of bordered pits in the metaxylem vessels. Simple perforations. Vessels separated by bands of small parenchyma cells. Similar cells are also present between the vascular tissue and bundle sheath. **Phloem** consists of sieve tubes and companion cells.

Aerial Stem.

Transverse sections of the stem exhibit an undulating outline owing to the presence of longitudinal ribs (Fig. 5) which are said by Pampanini and Bargagli-Petrucci to be absent from *S. pulvinaris* F. Muell. **Stomata** confined to grooves between the ribs. **Epidermis.** Cells over the ribs are large with thick and strongly cuticularised walls which are sometimes acutely convex (Fig. 6). Unicellular thick-walled **hairs** occur in this region in *S. pubescens*. Epidermis bounded on its inner side by a continuous and regular **hypodermis** (Fig. 6), consisting of a single layer of rounded parenchyma cells. A bundle of thick walled fibres (Figs. 5 & 6) is present in each rib and bounded externally by the hypodermis. Remainder of the **cortex** consisting of loosely packed, approximately spherical cells, apart from a few layers immediately outside the stele, where the cells are more rectangular and orientated tangentially. **Chlorenchyma.** Chloroplasts occur in cells of the cortex. Palisade tissue has been reported by Pampanini in *S. dielsi* Pampan., and in *S.*

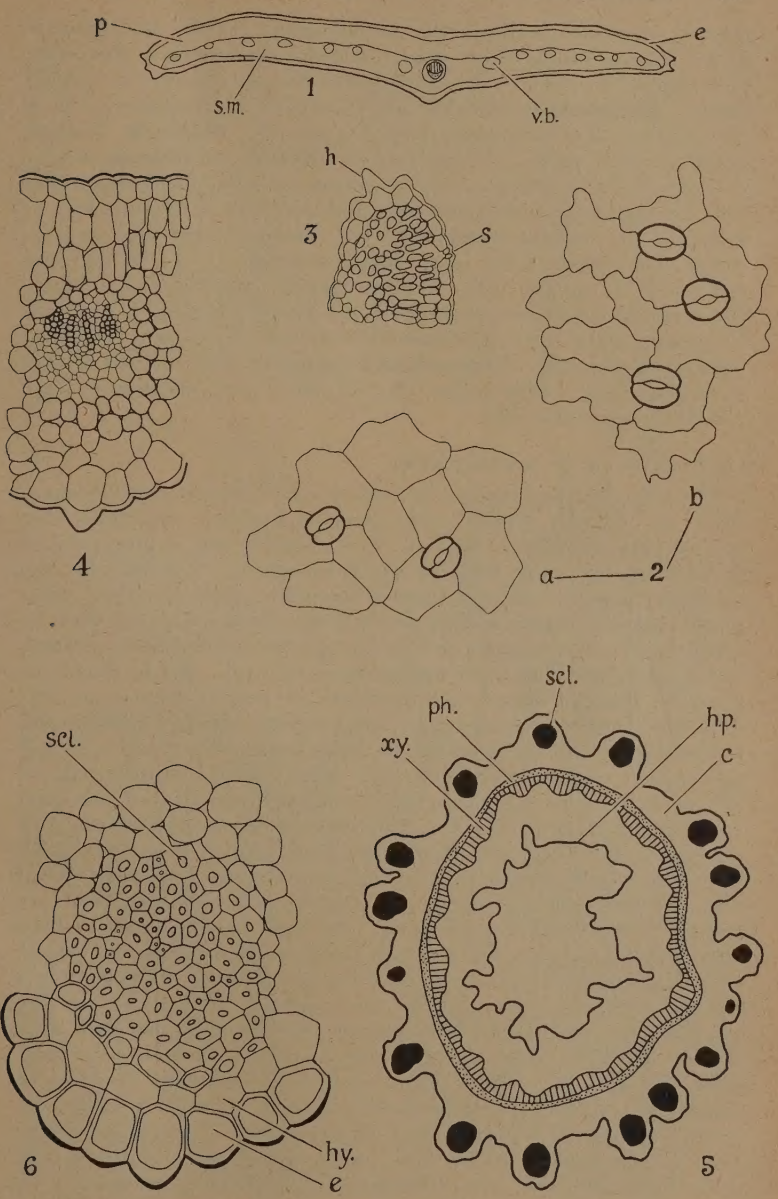

PLATE I. (Figs. 1–6). *Stackhousia monogyna.*

1. T.S. leaf × 20.
2. Stomata × 220 : (a) upper epidermis ; (b) lower epidermis.
3. T.S. leaf. Margin × 60.
4. T.S. leaf. Midrib × 100.
5. T.S. stem. Tissue diagram × 20.
6. T.S. stem. Rib × 220.

c. cortex, e. epidermis, h. hair, hy. hypodermis, h.p. hollow pith, p. palisade ph. phloem, s. stoma, scl. sclerenchyma, s.m. spongy mesophyll, v.b. vascular bundle, xy. xylem. T.S. Transverse Section.

pubescens the outer cortical cells are elongated radially in transverse section. Longitudinal series of large cylindrical elements in the cortex of *S. huegelii* are said by Pampanini and Bargagli-Petrucci to contain tannin. **Endodermis** indistinct in *S. monogyna*, and represented by a ring of thin-walled rectangular cells in *S. muricata*. **Pericycle.** Isolated strands of fibres present in most species. **Xylem** and **phloem** present in the form of a continuous, vascular cylinder, secondary xylem appearing very homogeneous in both transverse and longitudinal sections (Fig. 7) owing to the uniform diameter of the component elements and inconspicuous nature of the rays. **Rays** uniseriate, 1–3 cells high and composed of upright cells. Further details concerning the highly characteristic component elements of the xylem are given in the next paragraph, where their significance in relation to problems of xylem histology is discussed. **Protoxylem** is composed of narrow vessels with spiral thickening. **Pith** hollow (Fig. 5), outer part consisting of large rounded parenchyma cells.

Constituent cells of the Secondary Xylem.

It is a familiar fact that the secondary xylem in most dicotyledons is made up of vessels, which consist of vessel members, embedded in a ground tissue composed chiefly of fibres, together with a proportion of parenchyma that varies with the species concerned. Tracheids are also sometimes present. In most types of secondary xylem the above mentioned categories of elements are clearly distinguishable from one another, and they are woven together in a definite pattern which varies according to the genus, and sometimes the species, concerned. But in *Stackhousia monogyna*, although typical vessel members are present, there is no clear distinction between vessel members and tracheids, between tracheids and fibre-tracheids, whilst some of the tracheids are so short that they almost approximate to parenchymatous cells. Many of the constituent cells of the xylem combine the characteristics of more than one of the usual categories of cell types (Fig. 8). Thus we have cells in each of which one end wall is transverse and imperforate, as in a typical parenchyma cell, whilst the opposite ends of the same cells taper to fine points as in typical fibres. Other cells are similar but slightly more elongated and are pointed at both ends. Since these cells have bordered pits in their lateral walls, and they are of much the same diameter as the vessels, they might quite reasonably be regarded as tracheids. Or, they might equally well be interpreted as fibre-tracheids. Finally, there are the perforate cells that can be defined as vessel members, but even these are not all alike. Some of them have a simple perforation at or near either end (Fig. 10). Other vessel members are similar but have two, or sometimes only one, simple perforation at some distance from the end walls (Fig. 11). The mean length of 100 of these conducting elements from *S. monogyma* was 0·323 mm., the range being 0·152–0·578 mm. These figures also applied to *S. brunonis*, *S. huegelii* and *S. viminea*.

Although it is convenient to classify the component cells of the secondary xylem of the dicotyledons as vessel members, tracheids, fibre-tracheids, libriform fibres and parenchyma respectively, it is becoming increasingly clear that there are frequently no well defined distinctions between these cell types. This has been clearly shown, for example, by Bailey (1936)

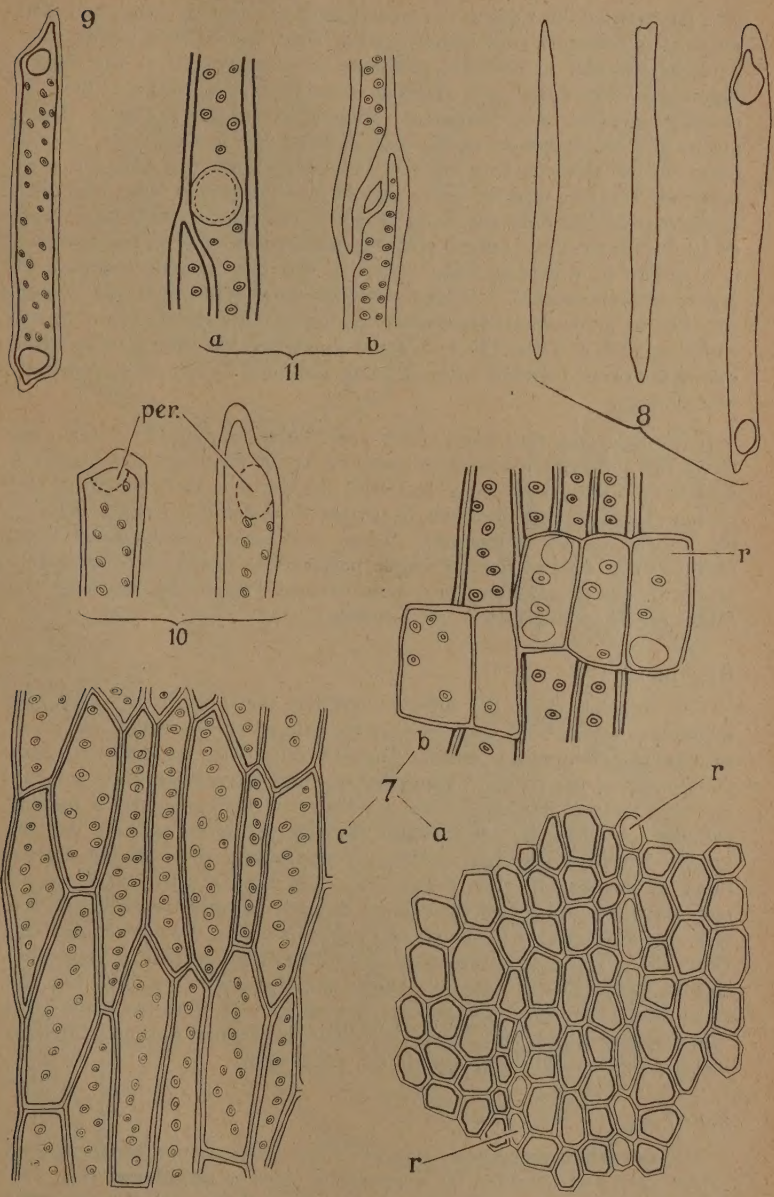

PLATE II. (Figs. 7–11). *Stackhousia monogyna.*

7. Secondary Xylem of Stem × 385 : (a) T.S. (b) R.L.S. (c) T.L.S.
8. & 9. Elements of Secondary Xylem from Stem Maceration × 220.
10. Terminal and Subterminal Perforations × 385.
11. Vessel Members of Secondary Xylem × 385 : (a) R.L.S. (b) T.L.S.

per. perforation, r. xylem ray. T.S. Transverse Section. R.L.S. Radial Longitudinal Section. T.L.S. Tangential Longitudinal Section.

who has pointed out that 'in the dicotyledons as a whole there is a graded series of imperforate cells which extends from typical thin walled tracheids at one end to fiber-like elements with simple pits at the other.' Bailey, it will be noted, was speaking of the dicotyledons as a whole. It therefore seems to be of even greater interest to find that in the secondary xylem of a single species of *Stackhousia*, there is a graded series of cells ranging from elements that are very like parenchymatous cells, but with bordered pits, to typical vessel members. Since it is now generally accepted that the different types of cell in secondary xylem have been evolved from a common prototype, it is significant to find that *S. monogyna* is a species in which so many stages in this phylogenetic sequence of events are represented. From the physiological standpoint, one would also like to know what determines the ontogenetic development of the cambium cells in a plant such as *Stackhousia* where the intergrading adult cells types occur together without being arranged in any easily recognisable pattern.

It is noteworthy that some of the transitional cell types in *S. monogyna* recall the elements intermediate between vessel members and tracheids that were observed by Lemesle (1947), in the secondary xylem of the root, and sometimes of the stem, in species of *Psychotria* or *Uragoga* belonging to the family Rubiaceae. These structures, which differ from ordinary tracheids in having simple perforations formed by the coalescence of several adjoining pits, were termed ' tracheides ouvertes ' or 'fibres aréolées conductrices ' by Lemesle.

Rhizome.

The rhizome (Fig. 12) differs from the aerial stem in having no sclerenchymatous ribs, and is covered externally by several layers of **periderm. Secretory cells.** Isolated cells with tanniniferous contents occur in the cortex. **Endodermis** and **pericyclic** fibres not observed. **Xylem** in the form of a solid core surrounded by a narrow cylinder of **phloem. Secondary xylem** exhibiting clearly defined growth rings : composed of elements resembling those in the corresponding position in the aerial stem. Occasional cells stand out in transverse section because their larger diameter contrasts with that of the cells of the otherwise homogeneous tissue in which they are embedded (Fig. 13). These cells are more vessel-like when seen in longitudinal section owing to their greater length and diameter (Fig. 14), but the remaining cells have the general appearance of fibre-tracheids with tapering end walls, some of which show simple perforations. There is less variation in cell shape than in the aerial stem.

Root.

The **cortex** is composed of large-celled parenchyma with scattered tannin cells and bounded by a superficial zone of **periderm** (Fig. 15). **Endodermis** represented by an irregular layer of thin-walled rectangular elements. **Xylem.** A small core of primary xylem is surrounded by a wide cylinder of secondary xylem and a narrow ring of **phloem. Secondary xylem** more heterogeneous than in other parts of the plant. In transverse section (Fig. 16) a number of large round vessels stand out from

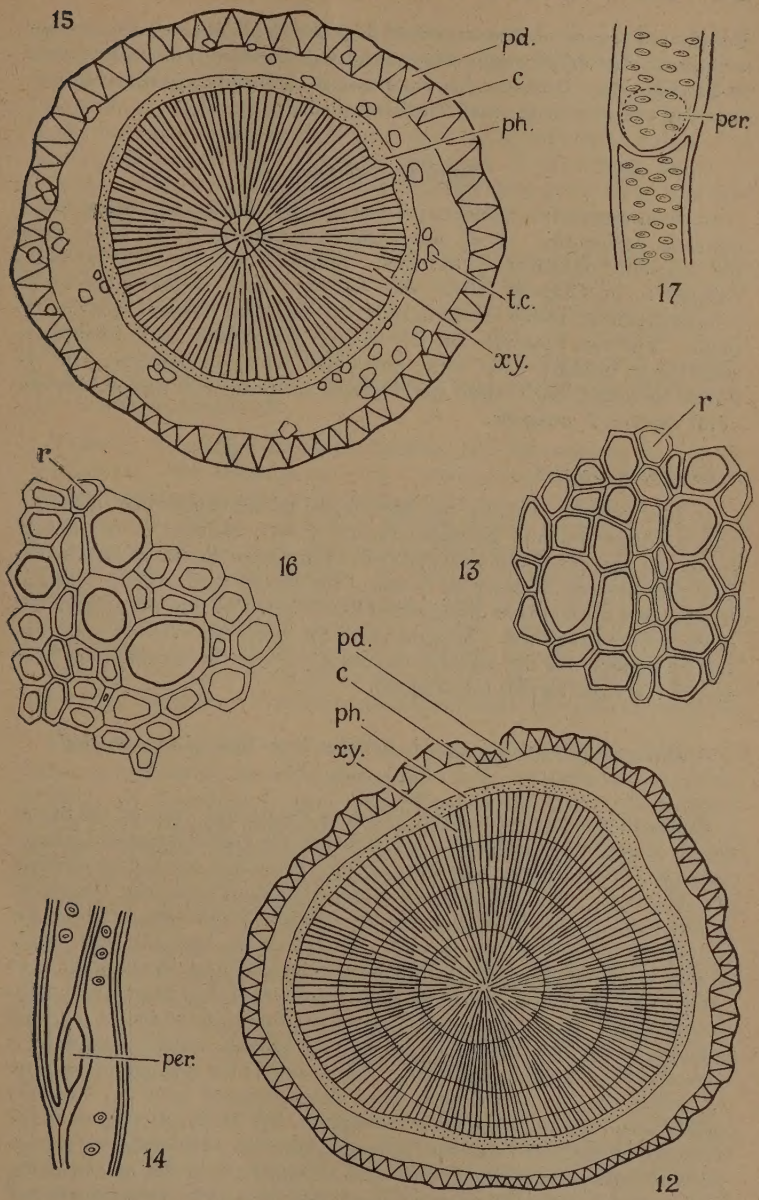

PLATE III. (Figs. 12–17). *Stackhousia monogyna.*

12. T.S. rhizome. Tissue diagram × 10.
13. T.S. Secondary Xylem of Rhizome × 385.
14. T.L.S. Portion of Vessel from Rhizome × 385.
15. T.S. root. Tissue, diagram × 40.
16. T.S. Secondary Xylem of Root × 385.
17. R.L.S. Vessel from Root × 385.

c. cortex, pd. periderm, per. perforation, ph. phloem, r. ray, t.c. tannin cell, xy. xylem. T.S. Transverse Section. R.L.S. Radial Longitudinal Section. T.L.S. Tangential Longitudinal Section.

the ground tissue. Each consists of a longitudinal series of short vessel members, with simple perforations and small bordered pits in the lateral walls (Fig. 17). Between them is a matrix of fibre-tracheids, which are tapering elements with small bordered pits.

Vessels in Stackhousia.

In *S. monogyna* the tendency to form vessels in the secondary wood increases basipetally. They are present occasionally in the aerial stem but are quite numerous in the root. A similar arrangement has been referred to by Cheadle (1942) who observed that, in many species of monocotyledons, vessels occur only in the root and nowhere else in the plant. The two examples are not strictly comparable since Cheadle is referring to primary tissue only, but a parallel trend has emerged. It should be noted that normal spiral vessels are present in the protoxylem of all parts of *S. monogyna.*

Rubber-like Deposits.

In this work no evidence has been found of the rubber-like substance which Pampanini and Bargagli-Petrucci (1905) claimed to be present in the leaf mesophyll and stem cortex of a number of species of *Stackhousia.* It is possible that *S. monogyna* is one of the species from which rubber is absent, and it may have disappeared from the herbarium material of the other species examined. Statements to the effect that rubber occurs in certain members of the Stackhousiaceae should not be accepted until the matter has been further investigated.

Discussion of possible taxonomic affinities in the light of the anatomical information.

Bentham and Hooker in their " Genera Plantarum " placed the Stackhousieae, as they were then called, between the Celastrineae and Rhamneae, to neither of which families do they show any marked anatomical resemblances. In the Englerian system, the Stackhousiaceae are placed in the large anatomically heterogeneous order Sapindales, between the Salvadoraceae and Staphyleaceae. Reference to Metcalfe and Chalk (1950) will show that both the Salvadoraceae and Staphyleaceae are very unlike the Stackhousiaceae so far as the structure of their vegetative organs is concerned. Hutchinson (1926) gives the Stackhousiaceae as the final member of the Celastrales, and, as in the Englerian system, the family is placed next to the Salvadoraceae. Since none of the taxonomic positions to which the Stackhousiaceae have been assigned seem to be very satisfactory from the anatomical standpoint, Mr. H. K. Airy-Shaw of the Herbarium staff was asked for further suggestions. He suggested a comparison between Stackhousiaceae and Selaginaceae in the first instance, and also with certain members of the Scrophulariaceae, Primulaceae and Lobeliaceae. Some of these suggestions proved to be very promising as will now be shown, the anatomical similarity of the Stackhousiaceae to certain of the Selaginaceae and Scrophulariaceae being in marked contrast to the considerable differences from families such as the Salvadoraceae and Staphyleaceae.

It must be emphasised that the following notes concerning the relationship of the Stackhousiaceae to the families suggested by Mr. Shaw, have been written at a time when the anatomy of many members of the families in question is very imperfectly known. It has not, in fact, been possible to do more than compare *Stackhousia* with the species that happen to be represented in the Kew reference collection of microscope slides. It should, therefore, be recognised that a modification of the views expressed may become necessary when more anatomical facts become available.

Comparing the Stackhousiaceae with the Selaginaceae it may be noted that the Selaginaceae also have vessels which are not very different in diameter from the surrounding fibres. In both families there are few or no fibres in the pericyclic region and the rays are inconspicuous or absent. Members of the Selaginaceae differ in having short glandular hairs of a characteristic type. Unicellular thick-walled hairs are the only type known in *Stackhousia*.

There is no marked similarity between the Primulaceae and Stackhousiaceae. The Primulaceae have a much greater range of hair types, and the vascular bundles of the stem are more widely spaced, especially in herbaceous species. In species of Primulaceae with well developed secondary xylem the rays, although comparatively narrow, are not so reduced as they are in *Stackhousia*. An exception is provided by *Lysimachia hillebrandi* Hook. f. from which rays are stated to be absent. Fibres are absent from the pericyclic region in certain genera and species of Primulaceae, but, in others, there is a definite ring of sclerenchyma in this region. In some Primulaceae the vessels of the primary wood are in long radial multiples, a character which is not observed in Stackhousiaceae.

There is no general agreement between all members of Scrophulariaceae and Stackhousiaceae, and on the whole the resemblances are not striking. It is possible to pick out certain genera of Scrophulariaceae which more strongly resemble the Stackhousiaceae. For example in species of *Diascia*, *Dermatobotrys*, *Euphrasia* and *Sutera* the wood resembles that of *Stackhousia* in having vessels that are not very different in diameter from that of the surrounding fibres. These genera also show absence of pericyclic fibres. It should be noted, however, that glandular hairs occur in all these genera and not in *Stackhousia*. The most notable resemblance is between *Stackhousia* and *Veronica*, for the rays are reduced in or absent from both genera. No vessel members of the peculiar types occurring in *Stackhousia* were seen in *Veronica*, but this genus has little or no sclerenchyma in its pericyclic region, and also exhibits wood fibres with bordered pits.

The suggestion that the Lobeliaceae might exhibit anatomical resemblances to *Stackhousia* does not appear to be supported by the anatomical evidence at present available. It should be noted that a laticiferous system occurs in the Lobeliaceae. This is of interest if it can be substantiated that rubber-like substances occur in the Stackhousiaceae, but, as pointed out above, this seems doubtful. In the primary wood the vessels are often in well marked radial rows and show spiral thickening. Scalariform pitting, and transitions between this and circular bordered pitting, occurs in *Centropogon*, *Lobelia* and *Pratia*.

Summary.

The anatomical structure of the leaf, aerial stem, rhizome and root of *Stackhousia monogyna* is described and briefly compared with that of herbarium material of certain other species of the genus.

The secondary xylem of the stem consists of a range of elements which are intermediate in type between true vessels and fibre-tracheids and between fibre-tracheids and parenchyma. A number of these elements were measured.

The presence of rubber-like deposits could not be substantiated in the material available. Some of the cortical cells of root and rhizome contain a tanniniferous deposit.

Some light is thrown on the taxonomic position of the family which is compared anatomically with members of the Selaginaceae, Primulaceae, Scrophulariaceae and Lobeliaceae. On the whole it most closely resembles certain genera of the Scrophulariaceae and Selaginaceae.

Acknowledgements.

The writer wishes to thank Dr. C. R. Metcalfe and Mr. G. Atkinson for their constructive comments, and help with the preparation of the text and illustrations, respectively. The author is also indebted to Miss D. M. Catling and Mr. F. R. Richardson who assisted with the microscopical preparations.

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A CORRECTION.

In publishing the new combination *Bulbostylis trifida* (Nees), I overlooked the fact that *Isolepis trifida* Nees was antedated by *Scirpus densus* Wallich, and also that the correct combination, *Bulbostylis densa* (Wall.) Handel-Mazzetti had been made (in Karsten and Schenck, Vegetationsb. XX, Heft 7, 16 : 1930). I am indebted to Dr. Hiroshi Hara, Tokyo, who kindly wrote to me and referred me to the complete synonymy of *Bulbostylis densa*, which he gave in Journ. Jap. Bot. 18 : 467 : 1942, accompanied by excellent drawings of its achene and that of *B. capillaris* (L.) C. B. Clarke, the species with which *B. densa* had long been confused.

E. Nelmes.

NOTES ON CYPERACEAE, XXVI.*

E. Nelmes.

New Annual Species of Pycreus from Tropical Africa.

Three of the four species of *Pycreus* described below grow with other annual plants in " laterite " areas in the Mwinilunga District of Northern Rhodesia. My colleague, Mr. E. Milne-Redhead, who collected specimens of these plants, informs me that *P. heterochrous* and *P. poikilostachys* occur together in the same area, without intermediates, and exhibiting what appears to be clear specific distinctness. The third species, *P. atro-rubidus*, was found in a similar habitat less than three kilometres away. The " seeds " (achenes) of these sedges must be highly resistant to heat for they successfully withstand about six months desiccation in full exposure to sunshine.

The Angola plant, as will be noted from the descriptions, is a larger plant than the others and belongs to a different section of the genus. Since Mr. Milne-Redhead discovered it in Angola it has been collected in the Belgian Congo by Mr. R. Germain, head of the Botany Division of Ineac at Yangambi.

Clavis Specierum.

Folia 1–1·5 mm. lata ; spiculae 3–4·5 mm. latae ; glumae 3–4 mm. longae, lutescentes, mucronatae . . . . . *xantholepis*

Folia filiformia ; spiculae 2–3 mm. latae ; glumae 2–2·5 mm. longae, muticae :

Bractea inferior patens ; culmi 4–15 cm. alti ; glumae circiter 2 mm. longae, atro-rubidae ; achaenium obovatum vel quadrato-obovatum, 0·9–1 mm. longum . . . . . *atro-rubidus*

Bractea inferior erecta, quasi culmi prolongationem efformans ; glumae 2·2–2·5 mm. longae :

Culmi 16–27 cm. alti ; anthela 1–10-spiculata ; spiculae 7–15 mm. longae ; glumae rubidae vel atro-rubidae ; achaenium oblongo-orbiculatum vel oblongo-obovatum, circiter 1·5 mm. longum . . . . . *poikilostachys*

Culmi 10–20 cm. alti ; anthela 1–4-spiculata ; spiculae 6–12 mm. longae ; glumae plerumque stramineae sed interdum brunneae vel rubidae ; achaenium late ellipticum, quadrato-ellipticum, vel suborbiculatum, 1·2–1·4 mm. longum . . *heterochrous*

Pycreus xantholepis *Nelmes*, sp. nov.

Herba annua. Culmi erecti, compresse trigoni, graciles, 20–35 cm. alti, laeves, subfirmi, inferne paucifoliati. Folia basi culmi sita, culmo breviora, 1–1·5 mm. lata, planiuscula, saepe demum flexuosa et torta, subflaccida ; vaginae rubentes vel vinaceae. Anthela simplex, laxa, 1–3-radiata ; radii inaequales, erecti, brevissimi vel 1–2 usque 4 cm. longi, distincte vel obscure trigoni, tenues, laeves, apice 1–4-spiculati. Bracteae 2–3, infima erecta, foliacea, anthelam multo superans, ceterae suberectae vel patentes, multo et gradatim minores. Spiculae in apice

*Continued from K.B. 1951, 166.

culmi spicatim confertae, terminalis erecta, laterales patulae vel patentes, compressae, oblongo-lanceolatae, apice acutae, 7–17 mm. longae, 3–4·5 mm. latae, 8–18-florae. Glumae subdense imbricatae, ovatae sed acuminatae, apice acutae, 3–4 mm. longae, rigidulae, lateribus lutescentes, lucidae, enerves, carina trinervi crassa pallide viridi in mucronem excurrente. Stamina 3. Stylus rubidus, profunde bifidus. Achaenium suborbiculatum vel obovato-orbiculatum, biconvexum, circiter 1·5 mm. latum, breviter apiculatum, demum nigricans, dense puncticulatum.

Angola : District of Moxico ; Ikula Hot Springs, by the river Zambesi on muddy pool in open, 17 Jan. 1938, *Milne-Redhead* 4213 (typus, Herb. Kew.) !

Belgian Congo : Ruzizi Plain, Tanganyika Lake, April 1950, *Germain* 6874 (Herb. Kew., Herb. Yangambi.) !

Pycreus atro-rubidus *Nelmes*, sp. nov.

Herba annua. Culmi erecti, obtuse vel obscure trigoni, graciles vel tenues, 4–15 cm. alti, laeves, subfirmi, inferne paucifoliati. Folia basi culmi sita, culmis altioribus multo breviora, culmis brevioribus subaequantia, filiformia, erecta vel suberecta ; vaginae rubidae, demum brunneae. Anthela simplex, contracta, 1–7-spiculata. Bracteae 1–2, patentes, inferior usque 3·5 cm. longa, superior spiculas haud superans saepe nulla. Spiculae in apice culmi spicato-digitatim confertae, terminalis erecta, ceterae patentes vel subpatentes, compressae, oblongo-lanceolatae, apice acutae, 5–10 mm. longae, 2–2·5 mm. latae, 10–18-florae. Glumae subdense imbricatae, ovatae, apice rotundatae vel bilobo-emarginatae, circiter 2 mm. longae, rigidulae, lateribus atro-rubidae, carina trinervi crassiuscula luteo-viridi apicem non vel vix attingente. Stamina 3. Stylus rubidus, profunde bifidus. Achaenium obovatum vel quadrato-obovatum, biconvexum, 0·9–1 mm. longum, 0·7–0·8 mm. latum, brevissime apiculatum, demum brunneum vel cinereum, dense minute puncticulatum.

Northern Rhodesia : Mwinilunga District : Kalenda Dambo, in shallow moist peaty soil overlying " laterite " in open, 14 Feb. 1938, *Milne-Redhead* 4565.

Pycreus poikilostachys *Nelmes*, sp. nov.

Herba annua. Culmi erecti, obscure vel obtuse trigoni, graciles, 16–27 cm. alti, laeves, subfirmi, inferne paucifoliati. Folia basi culmi sita, culmo plerumque breviora, interdum aequantia, filiformia, erecta vel suberecta ; vaginae fulvescentes. Anthela simplex, contracta, 1–10-spiculata. Bracteae 1–2, inferior foliacea, erecta, quasi culmi prolongationem efformans, anthelam multo superans, superior spicas aequans, patens, saepe nulla. Spiculae in apice culmi spicato-digitatim confertae, stellulatae, compressae, oblongo-lanceolatae, saepe reflexae, apice acutae, 7–15 mm. longae, 2–3 mm. latae, 10–18-florae. Glumae subdense imbricatae, oblongo-ovatae, apice rotundatae, 2·25–2·5 mm. longae, rigidulae, lateribus rubidae vel atro-rubidae, marginibus superne late albo-hyalinae, subundulatae, dorso pallide virides tricostatae, acumin-

atae, carina apicem vix attingente. Stamina 2. Stigmata 2. Achaenium oblongo-orbiculatum vel oblongo-obovatum, compresso-biconvexum-circiter 1·5 mm. longum, circiter 1 mm. latum, brevissime apiculatum, demum rubro-brunneum, dense minute puncticulatum.

NORTHERN RHODESIA : Mwinilunga District ; half a mile south of Matonchi Farm, on shallow moist soil overlying " laterite ", 24 Jan. 1938, *Milne-Redhead* 4311.

Pycreus heterochrous *Nelmes*, sp. nov.

Herba annua. Culmi erecti, obscure trigoni, tenues, 10–20 cm. alti, laeves, subfirmi, inferne paucifoliati. Folia basi culmi sita, culmo breviora, filiformia, erecta vel suberecta ; vaginae pallidae vel brunneae. Anthela simplex, contracta, 1–4-spiculata. Bracteae 1–2, inferior foliacea, erecta, quasi culmi prolongationem efformans, anthelam multo superans, superior brevissima, saepe nulla. Spiculae in apice culmi spicato-digitatim confertae, compressae, oblongo-lanceolatae, apice acutae, 6–12 mm. longae, 2·75-3 mm. latae, 10–20-florae. Glumae subdense imbricatae, ovatae, apice subacutae vel obtusissimae, 2·2–2·4 mm. longae, rigidulae, stramineae sed interdum brunneae vel rubidae, marginibus superne late albo-hyalinae, subundulatae, dorso pallide virides tricostatae carina apicem vel vix attingente. Stamina 2. Stigmata 2. Achaenium late ellipticum, quadrato-ellipticum, vel suborbiculatum, compresso-biconvexum, 1·2–1·4 mm. longum, circiter 1 mm. latum, basi valde stipitatum, apice breviter apiculatum, demum rubidum vel fusco-rubidum, dense minute cinereo-puncticulatum.

NORTHERN RHODESIA : Mwinilunga District ; half a mile south of Matonchi Farm, on shallow moist soil overlying " laterite ", 24 Jan. 1938, *Milne-Redhead* 4309.

Botany of Bikini*. It is rare nowadays for military operations to stimulate biological research, except in its medical aspects where the health and well being of troops is directly involved. The possible effects of atomic bombs were likely to be so far reaching and so unpredictable that, when " Operation Crossroads " was planned, the decision was taken to undertake a complete preliminary survey of the biology of Bikini Atoll and some neighbouring atolls in the Marshall Island group. Prof. W. R. Taylor's book deals with the whole of the plant life, terrestrial and marine, with the exception of the phytoplankton. Very little had previously been done on the flora of the northern Marshalls by either its German or Japanese overlords. The phanerogamic flora proved to be poor in species, as was to be anticipated from the position of the islands in the westerly drift of the North Equatorial current with no large island group between them and America. Gymnosperms, ferns and hepatics were entirely absent. A typical beach flora is not developed and the sand gives way to a fringing scrub of *Scaveola frutescens* (Mill.) Krause, frequently dotted with the golden tangles of the parasitic

*Plants of Bikini and other Northern Marshall Islands. W. R. Taylor. pp. xv + 218, tt. 79. Ann Arbor : Univ. Michigan Press. 1950. $5.50.

Lauraceae, *Cassytha filiformis* L. Sometimes on the windward side of the islands, *Suriana maritima* L. accompanies the *Scaveola* forming impenetrable thickets. Inland the coastal scrub gives way to thickets of *Guettarda speciosa* L. which perfumes the early morning air. The more barren parts are dominated by *Tournefortia argentea* L.f. scattered or forming low woodland. Where the soil is richer and humus has accumulated *Pisonia grandis* R. Br. develops a rich woodland with something of the aspect of a beech forest. Much of the *Pisonia* has been cut by the islanders to make way for coconuts.

Such vegetation is fairly characteristic of the small islets of this part of the Pacific and yielded nothing new. On the other hand the marine algal flora is somewhat richer in species and the annotated catalogue of algae occupies over 100 pages. It includes 14 new species and several new varieties. Massive coralline algae are the principal reef builders on the fringing reef, the commnest genus being *Porolithon*. Dredging in the lagoons brought up quantities of *Halimeda* and *Caulerpa*, but red algae were scarce and of little importance. As water depth and other conditions were favourable, the intense isolation was presumably responsible for their paucity. The same factor may account for the sparseness of the littoral algae. The presence of some world wide algae, such as *Enteromorpha*, was attributed to pollution, which increased and favoured their development during the stay of the expedition. Four maps are included and 75 other plates of photographs of excellent quality ; 53 of these depict the algae.

The Australian Bushland*—This interesting and readable book is largely based on the personal experience of the author who has travelled extensively through many parts of Australia. Not only has he been a great collector of the Australian flora but he has also made numerous observations on the vegetation. The publication of this work will surely serve to disseminate knowledge regarding the unique flora of the island continent and to stimulate many to investigate the numerous problems of taxonomy, phytogeography, and ecology still awaiting solutions.

The historical side of botanical research in Australia is dealt with after a brief general introduction. There follow summaries of the main features of the flora as a whole and of the states individually. The long interpolated tenth chapter contains accounts of eighteen botanical excursions in Victoria. These accounts should serve as guides to botanists visiting the areas and are, in addition, original accounts of the flora and vegetation of the areas concerned. Several chapters deal with special aspects of Australian forests, trees, clovers, grasses, introduced plants, indigenous fibrous plants, vascular cryptogams, monocotyledons, and cryptogams. Finally there are miscellaneous contributions on plant life, animal life, aborigines, erosion, etc.

The work is well illustrated with numerous photographs and some text figures. A glossary and a very full index are provided.

W. B. Turrill.

*" The Australian Bushland " by J. W. Audas, F.F.Sc. pp. 712, with photographic plates and text figures, W. A. Hamer Pty. Ltd., North Melbourne, Victoria, 1950.

CONOCARPUS LANCIFOLIUS ENGL.—AN INTERESTING SOMALILAND TREE.

F. N. Howes.

The Somaliland tree, *Conocarpus lancifolius* Engl., is of interest for several reasons. According to information recently received it shows promise under cultivation, on the coastal plain near Berbera, as a source of firewood and for providing building poles for Somali houses. It has been found to be quick growing, reaching a height of 50–60 feet in 10–12 years and giving long straight poles and limbs.

In its natural state in Somaliland the tree occurs at various altitudes up to 3,000 feet or more and is sometimes common in dry stream or river beds, which may possibly be accounted for by the presence of subterranean water. The wood has been described as light but hard grained. It is said to be well suited for making charcoal and to be used by the Somalis for fuel. The wood is also reputed to be employed for native dwellings and in canoe and boat building. Native names for the tree in British Somaliland are " damas " and " hodeti " (Glover).

In general characters the tree resembles *Conocarpus erectus* Jacq. a variable species well known as a shrub of the seashore in West Africa and in tropical America, where it is a common shrub (or tree) in swampy coastal areas and magrove associations. It is often referred to as " West Indian Alder " (from the resemblance of the fruits to those of the alder) and in Florida as " button wood ". In West Africa *Conocarpus erectus* is often to be seen as a thick or fleshy leaved evergreen shrub on the banks of salt lagoons near the sea. It appears to be unaffected by salt spray from the sea.

In spite of the affinity between *Conocarpus lancifolius* and *C. erectus* there are several noteworthy differences. The most obvious of these is the shape of the leaves, those of *C. lancifolius* being very much narrower and lanceolate in shape. The panicles of *C.lancifolius* are less dense than those of *C. erectus* and the flower heads smaller. The flowers have been described as cream coloured, strongly scented and attractive to insects. The cone-like fruits are also smaller and the seeds considerably smaller than those of *Conocarpus erectus*. As Engler has pointed out *C. lancifolius* affords an interesting example of a species closely related to a mangrove which occurs inland, away from the sea, and even at relatively high altitudes.

The curved scale-like seeds of *C. lancifolius* are produced in some abundance. They are small and light measuring only 2–3 mm. in length and width. About 1,700 seeds go the the gramme. It has been found in Somaliland that the seeds germinate readily provided proper care is given. The seeds are easily collected as the fruits ripen. These may be left in the sun for a few hours and then rubbed between the hands to remove stalks, etc., and to separate extraneous matter.

In raising seedlings it has been found that the seed bed should be in good tilth, and quite level so that water does not run off freely during the constant watering that is to follow. According to information received from Somaliland (from Mr. E. F. Peck, Director of Agricultural and Veterinary Services, Somaliland Protectorate) it has been found there that the seed is best sown on top of the soil and not covered at all for if it is covered with soil, however little, it may not germinate. " Watering

should be by watering can three times a day and not by flow irrigation. It should be copious each time. Watering like this should continue for four or five months, at the end of which time the seedlings will be one inch high. For another six months irrigation should be given daily, but it may now be by flow. The seedlings (which first show above ground one month after sowing) will now be up to 6 inches high. Watering may now be given every two days for another two months by the end of which time the seedlings will be 9 inches high. After this water once a week for five or six months. The seedlings may be transplanted after 12 months, but it is better to leave them in the nursery for 18 months. They should not be transplanted during the "haga" (hot, dry, dust laden wind of great intensity). After transplanting the young trees should be watered daily until they get their roots down to a water supply, which may be in 3 or 4 months or longer. Towards the end of the period during which the trees are being watered the quantity given daily should be progressively reduced ".

Further information on the transplanting of "damas" seedlings has been given by Peck as follows :—" When the damas seedlings are transplanted they are often six feet in height and the reason for this is that the water table in Berbera is about 5 ft. below the surface ; if the trees do not get down to water they have to be watered expensively. We therefore dig holes down to the dampness, possibly 4 ft., and the seedlings, if so large a tree can be so called, are planted at the bottom. A further reason why it is necessary to dig such holes is that at Berbera there are one and sometimes two layers of coral between the surface and the water and the roots of the damas cannot penetrate them and they have to be physically broken through. Yet a further point is that when the tree is down at the bottom of the hole it is essential that a few inches of it project above the surface for if a flood comes and the whole plant is submerged it will die."

An interesting point is that the tree does not appear to be affected in any way by the saline nature of the sub-surface water when planted near the sea coast. In this respect therefore, it would seem to show further affinity with its mangrove ally, *C. erectus*. Another point in the tree's favour in Somaliland is that its progress does not appear to be impeded by the south-west monsoon.

Engler, A. Monographieen Afrikanischer Pflanzen Familien und Gattungen **4**, 32.
Glover, P. E., 1947. A Provisional Check-List of British and Italian Somaliland Trees, Shrubs and Herbs.

Mycotrophy*. This attractively bound and printed volume contains a series of lectures on this subject by Dr. A. P. Kelly.

Work on mycotrophy has become so specialised and the literature on various aspects of this research so scattered that there was a real need for a book which would bring together the latest notions on this complicated subject. Dr. Kelly has now done this and on the whole with success, but one searches in vain for a critical appraisal of the work done by others.

The book contains much factual information and will be welcomed by workers in this field.

*Mycotrophy in Plants. By Dr. A. P. Kelly. Pp. xvi + 223. Waltham, Mass. : Chronica Botanica Co. ; London : Wm. Dawson & Sons, Ltd., 1950. Price $4.50.

DIAPENSIA LAPPONICA L. : ITS OCCURRENCE IN SCOTLAND.

R. A. Blakelock.

A specimen of this plant has recently been received at Kew from Miss M. J. Eldridge, B.Sc. It was collected by Mr. C. F. Tebbutt, F.S.A., in Inverness (vice-county 97) in the neighbourhood of Fort William on July 5th 1951 ; in the small area where the plant was noticed it was relatively abundant, covering low flat rocks with little or no other vegetation, and seemed to be in full flower. The locality is away from any path and above the 2,500 ft. contour, probably covered by snow for many months of each year.

Before considering the possibility of the plant being native its distribution and other relevant facts may be summarized. *Diapensia lapponica* is divided into two varieties var. *lapponica* (*genuina* E. Busch) (to which our specimen belongs) with linear-oblong leaves (9–17 mm. long, 1–1·5 mm. wide) and var. *obovata* F. Schmidt with obovate or obovate-oblong leaves (5–9 mm. long, 1·5–3 mm. wide). Var. *lapponica* occurs in the arctic and subarctic regions of N. America (E. of the Mackenzie Delta and with a southern extension in the Adirondack Mts. and mountains of New England), Greenland, Iceland, Norway, Sweden, Finland, Russia and N.W. Siberia (West of the Yenesei). Var. *obovata* is found in N.E. Siberia, Kamchatka, Commander Is., N. America (west of the Mackenzie Delta) (Evans, Polunin, Porsild, Hulten, Ostenfeld and Gröntved).

In Sweden Fiedler describes it as growing with *Loiseleuria procumbens* firmly anchored by long woody roots penetrating deep down into the network of cracks and fissures in the granite. The young plants have three or four rosettes, old plants up to a score. In E. Canada Polunin records it as "fairly frequent, and may be abundant quite locally. Grows chiefly in open sunny spots in heaths and on exposed barrens, where the snow is blown away and the plants must be frequently uncovered in winter. Flowers and fruits abundantly."

The plant has been in cultivation in this country. At Kew it is difficult to grow. In the Royal Botanic Garden, Edinburgh, the Japanese var. *obovata* is more vigorous than European examples of var. *lapponica* (see Evans). Fries regards this as one of the Swedish mountain plants that present the greatest difficulties in cultivation in Stockholm, where it has never attained a longer life than two or three years.

The indigenity of the plant in Scotland may be considered next. The remoteness of the locality is against its being an *accidental* escape from a garden, and the natural distribution might well include Scotland. On the other hand the possibility of *deliberate* planting by persons unknown, whether as an ecological experiment, as an attempt to add to the flora of Scotland, or as a hoax, cannot be ignored. The Highlands are frequently visited by those interested in alpine plants and the plant is attractive and fairly conspicuous when in flower. These two points favour the possiblity of its being planted and the improbability of its being native. Whether the species is native or not, it will be worth noting if it continues to maintain itself.

It may be added that Druce does not mention the species in his works on George Don, nor does Skalinska.

Diapensia lapponica L. forms rounded tufts 2–5 cm. high, the leaves are linear-oblong obtuse, glabrous and leathery, forming rosettes with the dead leaves remaining at base of the stem. The scape is 1·5–4 cm. high. There are 2–3 bracts immediately below the calyx and often one or two towards the middle of the scape. The sepals are oblong with rounded almost truncate tips. The corolla is saucer-shaped, white and 1–1·5 cm. in diameter with five rounded entire lobes. The genus is a member of the Diapensiaceae, in Bentham and Hooker's Genera Plantarum it is placed between the Epacridaceae and the Plumbaginaceae.

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ON THE DIONCOPHYLLACEAE, A REMARKABLE NEW FAMILY OF FLOWERING PLANTS.

H. K. Airy Shaw.

Introductory

The following account attempts to bring together what is at present known concerning one of the strangest groups of plants to be found in the vegetable kingdom.

Many friends and correspondents have assisted in the work, and it is a pleasure to acknowledge here their kind and generous help.

Mr. F. C. Deighton, assisted by his colleagues Messrs. T. S. Jones, A. F. Mackenzie and W. F. Steven, of the Department of Agriculture, Sierra Leone, went to great trouble to obtain additional (including spirit) material of *Dioncophyllum peltatum* and *D. Dawei*, and loaned all the material of this genus from the Herbarium of their department at Njala. M. Georges Le Testu, of Caen, formerly of the Service Forestier in the French Congo, and M. François Pellegrin, of the Muséum National d'Histoire Naturelle, Paris, furnished me with much information regarding *D. Tholloni* and were instrumental in procuring for me the loan of all the material of this rare species in the Paris Herbarium. Mr. A. C. Hoyle, of the Department of Forestry, Oxford University, kindly loaned the material from the Herbarium in his charge. Dr. J. T. Baldwin, Jr., kept a special look-out for *Dioncophyllum* during his journeyings in Liberia and sent several collections of *D. peltatum* from that country, while Mrs. W. J. Harley, of Ganta, Liberia, forwarded an exceptionally good fruiting specimen of the same species from that area. Through the intermediary of Dr. C. R. Metcalfe, M. Jacques Miège forwarded material of *D. peltatum* from the extreme eastern limit of its range in the western part of the Côte d'Ivoire.

To three of my colleagues I am under a special debt of gratitude. Firstly to Mr. E. Milne-Redhead, in charge of the African section of the Herbarium, who originally drew my attention to this extraordinarily interesting group, and has since then given constant encouragement and help, both in securing the interest and co-operation of collectors in West Africa and in many other ways. Secondly to Dr. C. R. Metcalfe, of the Jodrell Laboratory, who took up the anatomical investigation of the group *molto con fervore*, and has produced the detailed account which follows this paper and speaks for itself. Thirdly, and not least, to Mr. G Atkinson, official Kew artist, who amid the constant distractions of many other duties has provided the fine series of drawings illustrating this paper, and conveying far more than many pages of text. I am also much indebted to Mr. P. Taylor for the outline maps, and to many other friends and colleagues for innumerable discussions on the morphology and ' affinities ' of the astonishing *Dioncophyllaceae*.

Historical

The history of the interesting group which forms the subject of this paper commences with the description by Baillon in 1890 of the then new genus and species, *Dioncophyllum tholloni* Baill., based on a plant originating in the Niari district of Moyen Congo in French Equatorial Africa, to

the west of Brazzaville, in the extreme south of the colony. Baillon regarded this strange plant, of which the fruits and seeds were then unkown, as a link between the *Bixaceae* (i.e. *Flacourtiaceae*) and *Passifloraceae*, but did not express an opinion as to which of these families it approached the more closely.

Shortly afterwards, Warburg (1893) included *Dioncophyllum* definitely in the *Flacourtiaceae*, even to the extent of associating it with *Scolopia* and *Streptothamnus* in his subtribe *Scolopieae-Euscolopieae* ; but he remarked that " the tendril-development rendered it possible that the genus might belong to the Passifloraceae ".

A more complete description of *D. tholloni*, based on the type-specimen, was published by Gilg in 1908. He regarded it as certain that the plant could not be referred to the *Passifloraceae* : " *Dioncophyllum* is definitely a *Flacourtiacea*, at least if one defines the family as broadly as does Warburg"; but he thought it at least very doubtful whether its rightful place was in the neighbourhood of *Scolopia* and *Streptothamnus* ; it would be better treated as the representative of a special section of the family.

Sterile material* received at Kew in 1914 from Sierra Leone led Sprague (1916) to re-investigate the structure and affinities of this remarkable genus. He published a fresh description, and a figure, of the vegetative parts, based on the Sierra Leone specimens*, adding a translation of Baillon's description of the inflorescence and flowers. An account of the anatomy of the stem and leaves, by Miss F. M. Scott, was appended. After discussing the morphology of the leaves and their hooked tendrils, Sprague gives it as his opinion that " the genus should be referred to the *Passiflorales*, *sensu lato*, including the *Flacourtiaceae*, *Bixaceae*, *Cochlospermaceae*, *Violaceae* and *Cistaceae* in addition to the families referred to it by Bentham and Hooker, but cannot yet be assigned to any family ". He regarded " the presence of cortical bundles and internal phloem†," and of peltate scales, as lending further weight to this view. But his concluding paragraph was significant : " The great resemblance which *Dioncophyllum* bears to *Nepenthes* should also be kept in mind as possibly indicative of a remote affinity with the *Sarraceniales*. The lamina-like organ terminated by a double tendril (there is only one tendril in *Nepenthes*), the presence of peltate scales, and the extra-axillary ebracteate inflorescence suggest an affinity with *Nepenthes*, but the floral characters are very different. The fruit‡ and seeds, when known, will probably shed light on the relationships of this remarkable plant." It is hoped to show that Sprague's suspicion of Nepenthaceous affinity was correct. The same view was expressed not long afterwards in more definite and positive terms by Hans Hallier (1921), without, however, making any reference to Sprague's paper.

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*Of the species later described as *D. peltatum* Hutch. et Dalz.

†Dr. Metcalfe points out that the term ' internal phloem ' is probably used by Sprague & Scott in the sense of ' inter-xylary phloem ', but that the only family of *Passiflorales* (sensu B. & H.) in which this feature is known to occur is the *Cucurbitaceae*. This family and *Begoniaceae* are likewise the only *Passiflorales* in which cortical bundles are known ; they also occur in the *Turneraceae*, a family closely related to *Linaceae* (cf. p. 332, *infra*).

‡The fruit turns out to be a loculicidal capsule—as in *Nepenthes*—but of a highly original type.

In his account of the *Flacourtiaceae* for the second edition of Engler's *Pflanzenfamilien*, Gilg (1925) went so far as to erect for *Dioncophyllum* the special subtribe *Scolopieae-Dioncophyllinae*, accompanying it with the singularly unfortunate comment that " die Gattung wird zu unrecht von Hallier f. . . . von den *Flacourt.* entfernt und in verwandtschaftliche Beziehungen zu der Gattung *Nepenthes* gebracht." (This statement is repeated by Guinea López (1946) .) One is reminded of the proverb, " There are none so blind as those who *won't* see."

Meanwhile, at Kew, additional material of *Dioncophyllum* had been accumulating, mainly from Sierra Leone, and in the *Flora of West Tropical Africa* Hutchinson & Dalziel (1927) described two new species of this remarkable genus. Formal descriptions were published elsewhere by the same authors the following year (Hutchinson & Dalziel, 1928). These species, however, especially *D. dawei* Hutch. et Dalz., differ so markedly from *D. tholloni* in several important points that they must be placed in separate genera. The second new species, *D. peltatum* Hutch. et Dalz., collected first as sterile material by Mann in Sierra Leone as long ago as 1861, was shortly afterwards recorded from Liberia (Cooper & Record, 1931), though, again, sterile material of it had been collected there by R. H. Bunting as early as 1910.

The last important contribution to our knowledge of the group was an account by Pellegrin (1933), accompanied by a good figure, of the fruit and seed-development of *D. tholloni*, based upon fruiting material then recently obtained in the Gaboon district of French Equatorial Africa. Pellegrin ventured no comments on the affinities of the plant.

Affinities

The writer's attention was drawn to the genus by Mr. E. Milne-Redhead when a further collection of *D. dawei* from Sierra Leone was received at Kew in 1947. The conviction was at once born, and steadily grew, that *Dioncophyllum* had nothing whatever to do with the *Flacourtiaceae*. On the other hand, the suggestion tentatively put forward by Sprague (1916) and strongly advocated by Hallier (1921) that the genus was related to the *Sarraceniales*, and especially to *Nepenthes*, immediately commended itself. Moreover, a short MS report by the late L. A. Boodle on the morphology and anatomy of sterile material of *D. peltatum*, drawn up in 1912 and preserved in the Kew Herbarium, points out the very great agreement, both morphologically and structurally, between the capitate glands of that species and those of *Drosophyllum lusitanicum* (L.) Link, a remarkable suffrutescent member of the *Droseraceae*. The *Droseraceae* are, of course, included by Engler in the *Sarraceniales*. Boodle also states that the peltate scales on the leaves of *Dioncophyllum peltatum* " are not widely different from the stellate hairs of *Dionaea*." Moreover the gland-leaves of the *Dioncophyllum* are coiled circinately in vernation*, exactly like those of *Drosophyllum*; the petals are delicate in texture and convolute in aestivation in both (cf. Lloyd, 1942, p. 99); and the much-branched styles recall those of many species of *Drosera*.

* A field-note to a specimen collected by J. Bequaert in Liberia reads : " Flowers [sic !] small, in uncoiling fern-like spike."

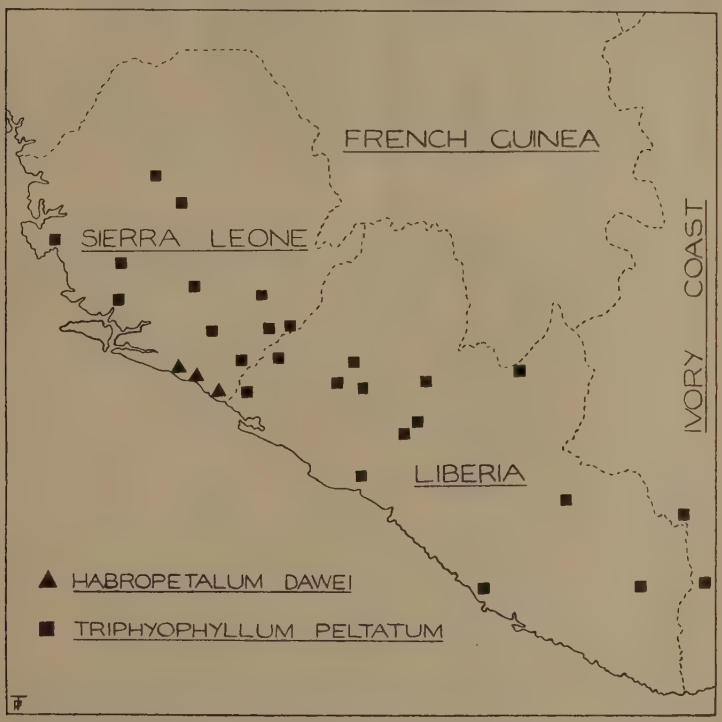
There is also, however, at least a morphological similarity in what would be regarded by some taxonomists as quite another quarter, namely among the *Parietales*, particularly in the subfamily *Kielmeyeroïdeae* of *Guttiferae*, and especially in the genus *Kielmeyera* itself. This genus,

General distribution of the three genera of *Dioncophyllaceae*.

of about 20 species of trees, shrubs and half-shrubs, is almost confined to the drier parts of southern Brazil, forming a characteristic element of the *campos* of Minas Geraes, Goyaz, Matto Grosso and neighbouring provinces. *Kielmeyera* is one of the three genera in this subfamily possessing alternate leaves, and the leaves of *K. pumila* Pohl are strongly reminiscent, in shape, texture and venation, of those of *Dioncophyllum peltatum* Hutch. et Dalz. In the small open calyx, with acute deltoid teeth, and in the much larger petals, fleshy or almost leathery in texture and contorted in aestivation, there is a marked resemblance between *K. pumila* and both *D. peltatum* and *D. tholloni* Baill. The stamens of *Kielmeyera* are considerably more numerous than those of *Dioncophyllum*, but the elongate anthers of *D. tholloni* are quite comparable with those of such species of *Kielmeyera* as *K. corymbosa* Mart., *K. coriacea* Mart., *K. neriifolia* Camb., etc. The gynoecium of *Dioncophyllum tholloni*, with its 5 free styles, may be compared with that of some other genera of *Guttiferae* such as *Vismia*, *Psorospermum*, etc. (The rusty indumentum is also very similar to that of many *Vismieae*.) The embryo of *Dioncophyllum dawei*, with its flat, semicircular, subcordate cotyledons and very short radicle, is very like that of *Kielmeyera* (cf. Mart. *Fl. Bras.* **12** (1), t. 60, figs. 35, 36b) on a larger scale. It is to be noted, however, that these morphological similarities do not extend to the anatomy (cf. Dr. Metcalfe's remarks, p. 367 *infra*).

That *Dioncophyllum* should provide a link between the *Sarraceniales* and *Parietales* (Suborder *Theineae*) may seem at first startling. But a closer examination of the two groups discloses other points of similarity. Both *Nepenthes* (Sarrac.) and the *Guttiferae-Clusioïdeae* (Pariet.) show a strong

tendency to dioecism, tetramery (*Garcinia* etc.), synandry, and a massive pileiform stigma. The inflorescence of *Nepenthes* (when not reduced to a simple raceme) is strongly reminiscent of that of *Cespedesia* in *Ochnaceae* (Pariet.) and the capsule and scobiform seeds are strikingly similar in both. In the shape, texture, venation and habit of the leaves of *Nepenthes*



Localities from which *Habropetalum* and *Triphyophyllum* have been collected.

(omitting the tendrils and pitchers) there is often more than a suggestion of those of *Ternstroemiaceae* (sensu stricto, i.e. *Theaceae-Ternstroemioïdeae*), *Marcgraviaceae* and *Bonnetiaceae* (Pariet.) This was noticed by Hallier (1921), who wrote : " *Dioncophyllum Thollonі* Baill. . . . stimmt . . . in der Tracht sehr stark mit *Nepenthes* überein und durch die zahlreichen, fast horizontalen, parallelen feinen Nerven des ganzrandigen Blattes mit zahlreichen Ochnaceen, Guttiferen, Thymelaeaceen,* Vochysiaceen, Myrtaceen, Myrsinaceen, Sapotaceen,* und anderen Abkömmlingen von Linaceen, sowie mit Vertretern der letzteren Familie selbst. Es dürfte in die Nähe von *Nepenthes*, den Parnassiaceen* (einschl. Sarracenieen) und den Marcgraviaceen zu den Guttalen gehören. . . ." (*l.c.* 38).

* I doubt whether the *Thymelaeaceae* and *Sapotaceae* have any significant connection with the circle of affinity under discussion, though they appear to be connected *inter se* by means of the Thymelaeaceous genus *Microsemma* Labill. Nor is it easy to follow Hallier in including *Parnassia* in the *Sarraceniales*.

The connection of *Dioncophyllum* with the suborder *Theineae* of *Parietales* is thus seen to be a fairly strong one. But there is also a strong connection with the genus *Ancistrocladus*, sole member of the family *Ancistrocladaceae*, forming Engler's suborder *Ancistrocladineae* of the same order *Parietales*. *Ancistrocladus* is a genus of hook-climbers of similar habit to *Dioncophyllum*, but with hooks formed by modified branches instead of by the leaf-apex. The general leaf-shape, texture and venation of *D. peltatum* is quite reminiscent of *Ancistrocladus* species, and the turbinate embryo with thin leafy divaricate cotyledons appears to be built on an essentially similar plan in both genera. It is, however, in the anatomy that the most striking agreement is found, and the reader is referred to the section dealing with this which has been kindly supplied by Dr. Metcalfe (see p. 366, *infra*).

Finally, as noted by Hallier (*l.c. supra*), there are significant morphological links with the *Linaceae* (incl. *Turneraceae* !). The large, delicate, fugacious petals of *Dioncophyllum dawei*, contorted in aestivation, are altogether similar to those of several genera of *Linaceae*—as also to those of *Drosophyllum*, in the *Droseraceae*, to which reference has already been made. And the hook-forming tendency, present in *Ancistrocladus*, finds expression also in *Linaceae*, in the form of the remarkable branch-hooks of *Hugonia* and *Indorouchera*—paired and single respectively. The leaf-hooks of *Dioncophyllum* are doubtless homologous with the tendril-functioning midrib-prolongation (pitcher stalk) of *Nepenthes*.

The ' linkages' shown by *Dioncophyllum* with a variety of ' distantly related ' groups illustrate well the principle of ' sharing of genes ' propounded by Hayata (1921). It is particularly striking that different sets of linkages are exhibited by each of the three known species. Thus, only *D. dawei* shares with the *Linaceae* and *Drosophyllum* the character of delicate fugacious petals ; only *D. peltatum* shares with species of *Drosera* the character of copiously branched styles, and with *Drosophyllum* the character of linear circinate leaves with massive stalked glands ; only *D. peltatum* and *D. tholloni* share with *Kielmeyera* the characters of a small open calyx with deltoid lobes, combined with thick almost coriaceous petals. All three species, however, share anatomical features with *Nepenthes* and *Ancistrocladus*, and other features with either the one or the other of these genera. It is suggested that the best location for the *Dioncophyllaceae* in any scheme of ' classification ' is possibly in the *Sarraceniales*, near *Nepenthaceae*.

In order to do justice to the profound differences which exist between the three known species, it is evident that three distinct genera must be recognized. *Dioncophyllum dawei* is the most isolated of the three, especially in its large valvate sepals, delicate fugacious petals, two carpels and bulky seeds, and in its ecology. But *D. peltatum*, in its trimorphic leaves—one type practically reduced to a midrib studded with stalked viscid glands similar to those of *Drosophyllum*—and in other characters, represents something widely different from *D. tholloni*, and is equally worthy of generic rank. A key to the three genera will be found on p. 333, immediately after the family description.

There can be few groups of plants that exhibit so many unusual and bizarre characteristics as the *Dioncophyllaceae*. Some of these features appear to be unique. The elongate, thickened, rigid funicles upon

which the almost ' gymnospermous ' seeds are borne are surely without parallel in the plant kingdom. The prolongation of the leaf-midrib into a pair of curved hooks is likewise unique, though the strangeness of this is exceeded in the pitcher-development of *Nepenthes*. The astonishing circinate gland-leaves of *Dioncophyllum peltatum* find their only possible parallel in *Drosophyllum lusitanicum*. But the fact that all these strange features are combined in one small group of plants is clearly of more than ordinary interest, and it may be hoped that this preliminary study may lead in due course to more detailed investigations, especially in the field. The germination and seedling stages, for example, may be expected to show interesting and unusual features, and might possibly throw light on the ecological or climatic niche to which these remarkable plants were originally adapted.

Description of Family

Dioncophyllaceae *Airy Shaw*, fam. nov. *Flores* hermaphroditi, actinomorphi. *Calyx* pentamerus, tubo brevissimo vel subnullo, segmentis vel brevibus aestivatione apertis vel elongatis valvatis herbaceis persistentibus. *Corolla* pentamera ; petala inter majora, libera, aestivatione contorta, vel crassiuscula vel tenera, caduca. *Discus* nullus. *Stamina* hypogyna, 10 vel ∞, libera vel vix connata, aequilonga vel inaequilonga, brevia vel elongata, recta, antheris elongato-linearibus vel breviter ellipsoïdeis. *Ovarium* superum, uniloculare, bi- vel quinquecarpellare, cito ' loculicide ' apocarpum, placentis medianis (revera marginalibus). *Styli* vel 5, filiformes, liberi, stigmate parvo vix expanso, vel 2, filiformes, liberi, stigmate capitato, vel 5 basi subconnati, superne plumoso-laciniati. *Ovula* anatropa, serius describenda. *Fructus* junior obovoideus vel pyriformis vel globosus, maturus stellaris vel bilobus, e valvis 5 vel 2 apertis liberis patentibus sistens. *Semina* pauca, magna, disciformia, crassa vel tenuia, late vel latissime alata, in funiculis valde elongatis incrassatis rigidis apice articulatis peltatim affixa et e ' capsula ' aperta longe porrecta. *Embryo* magnus, discoïdeo-obconicus, axilis, radicula brevissima hilo opposita ; albumen copiosum, pileiforme, embryonem pro maxima parte circumdans.

Frutices scandentes, ligno molli, copiose vel parce rubiginoso-lepidoto-furfuracei. *Folia* alterna, elongata, simplicia, aut heteromorpha (alia simplicia alia apice biuncinata alia lamina partim vel omnino evanida ad costam glandulis magnis stipitatis sessilibusque obsitam redacta) aut homomorpha (omnia apice biuncinata), integra vel crenulata, saepe undulata, chartacea vel coriacea, patentim parallelo-nervosa, exstipulata. *Inflorescentiae* varie laxe cymosae, ± supra-axillares. *Bracteae* amplae vel minutae. *Flores* mediocres, petalis albis.—Syn. : *Flacourtiaceae-Scolopieae-Euscolopieae*, pro minore parte, Warb. in Engl. et Prantl, *Nat. Pflanzenf.* III, **6a**, 28-30 (1893) ; *Flac.-Scol.-Dioncophyllinae* Gilg in *op. cit.* ed. 2, **21**, 390, 420–1 (1925).

Key to Genera

Inflorescence rather dense-flowered, conspicuously bracteate ; sepals large, elongate-elliptic, valvate, closed in bud ; petals large, delicate in texture ; stamens 10, elongate ; styles 2, free, filiform ; valves of ' capsule ' 2, small and inconspicuous in comparison with the massive thickened funicles and seeds ; seeds large and massive (but

light), with a relatively narrow (1–2·5 cm.), spreading or ± reflexed, non-shining wing ; indumentum conspicuous, rufo-furfuraceous ; stem finely striate ; petiole broad, narrowly winged, not articulate. (Sandy coastal scrub-land of S.E. Sierra Leone.)
1. **Habropetalum** A.S.

Inflorescence lax-flowered, bracts small and inconspicuous ; sepals small, deltoid, open in bud ; petals relatively small, thick and subcoriaceous ; seed-body small, with a very broad (4–5 cm.) flat shining golden-satiny wing ; indumentum minute or absent ; stem mostly smooth and terete ; petiole rather slender, not winged. (High forest lianes).

Leaves homomorphic, shallowly crenulate, prominently and closely nerved ; petiole not articulate ; inflorescence elongate, open ; stamens 10 or 25–30 (!), elongate ; styles 5, free, simple ; valves of ' capsule ' 5, elongate, linear, 7–8 cm. long. (French Congo.)
2. **Dioncophyllum** Baill. *s. str.*

Leaves trimorphic (hook-bearing on the long shoots, simple on the short shoots in their axils, and occasional linear gland-bearing ones on young coppiced growth), entire, nervation immersed and relatively lax, rather obscure ; petiole articulate midway, base persistent ; inflorescence short, few-flowered, on axillary short shoots ; stamens 10, very short ; styles 5 (sometimes 3 ?), much branched above ; valves of ' capsule ' 4–5, relatively short, elliptic to oblanceolate-spatulate. (Sierra Leone, Liberia, Ivory Coast.)
3. **Triphyophyllum** A.S.

1. Habropetalum.

Habropetalum *Airy Shaw*, gen. nov., a *Dioncophyllo* Baill. bracteis magnis conspicuis, sepalis magnis elongato-ellipticis valvatis alabastro clausis, petalis magnis textura teneris, stylis 2 liberis simplicibus filiformibus, capsula parva bivalvi, seminibus magnis crasse discoïdeis pro rata anguste alatis haud nitentibus inter alia distinguenda. ἅβρος, tener, delicatus).

Sepala 5, elongato-lanceolato-elliptica, aestivatione valvata, basi brevissime connata. *Petala* 5, magna, spatulato-obovata, textura tenerrima (ut in *Drosophyllo*, *Lino*, *Iride*, etc.), sepalis subduplo longiora, aestivatione contorta, fugacia, tenuiter subparallele nervosa. *Stamina* 10, filamentis elongatis filiformibus, antheris breviter ellipsoïdeis. *Ovarium* parvum, obovoïdeum. *Styli* 3, filiformes, elongati, stigmate capitato. *Ovula* serius describenda. ' *Capsula* ' bivalvis, ab initio aperta: valvae parvae, inconspicuae, suborbiculares, horizontaliter patentes vel reflexae et margine reflexae, velut collare bilobum reflexum supra calycem persistentem efformantes. *Funiculi* valde aucti et incrassati (maxime apice et basi), usque 4 cm. longi, 1 vel 2 ex utraque valva orti, patentes. *Semina* magna, crasse discoïdea, lignosa, sed levis ponderis, ala lata brunnea striata saepe plus minus reflexa circumdata.

Frutex scandens. *Caules* plus minus teretes, tenuiter striati, conspicue ferrugineo-furfuracei. *Folia* alterna, breviter petiolata, petiolo lato anguste alato, elongato-oblonga, tenuiter coriacea, crebre parallelo-nervosa, nervis angulum fere rectum cum costa efficientibus, margine

PLATE I. HABROPETALUM DAWEI (Hutch. et Dalz.) Airy Shaw.

Fig. 1, flowering branch, *nat. size*. 2, flower-bud, × 2. 3, stamen, × 8. 4, gynoecium, × 8. 4a, gynoecium with abnormally short styles, × 8. 5, fruit, showing two funicles and a mature seed, *nat. size*. 5a, young seed, × 2. 6, mature seed, in basal (ventral) aspect, *nat. size*.

undulato, costa apice in uncum duplicem excurrente. *Inflorescentiae* axillares et terminales, axillares paullo supra axillas ortae, indeterminate cymosae, densiflorae, conspicue bracteosae, ferrugineo-furfuraceae. *Flores* majusculi, quam ii *Dioncophylli* brevius pedicellati, alabastro lanceolato-conici.

Habropetalum dawei (*Hutch. et Dalz.*) *Airy Shaw*, comb. nov.

Dioncophyllum dawei Hutch. et Dalz., *Fl. W. Trop. Afr.* **1** (1), 163–5, fig. 70 (1927), et in *Bull. Misc. Inf.*, Kew, **1928,** 31 (1928) ; Pellegr. in *Bull. Soc. Bot. Fr.* **80**, 234, 236 (1933) ; Dalz. *Usef. Pl. W. Trop. Afr.* 47 (1937).

Sierra Leone. Southern Province. Pujehun District :—Mosente (Kwako Krim Chiefdom), 8 Dec. 1949, *W. F. Steven* for *Deighton* 5283 ; ibid., March 1950, *Deighton* 5323 (fruit !) : " This seems to be about the western limit of range of this species." Vernacular name (Krim-Mende), *sangi*. Mano Bonjema (Mano Sa Krim Chiefdom), coastal sandy lands, Feb. 1923, *Dawe* 466(type). Ibid., 1926, *Meama* for *Dawe* s.n.: " This plant is known locally among the Krims as *sangai* and it is employed in the same way as it is employed elsewhere ". Ibid., 1926, *Paramount Chief Francis Fawundu* for *Dawe* s.n. (seeds only). Ibid., on sandy soil in regenerating bush, common, 15 Jan. 1946, *Adames* 1 : " Scrambling shrub ". Juring (Gbema Chiefdom), 2 Dec. 1926, *Deighton* 332 : " Rather common in the Mano Salija to Juring area, on sand. A shrub, climbing where it can ; but it does not often have much chance as the natural vegetation seems to be very sparse and grassy. Flowers white. As far as I could see, they open in the early morning, and fall before noon ; others open in the late afternoon and they fall in the morning."

A description of the previously unknown infructescence and capsule, and an amplified description of the seeds, is given herewith. (See also Plate I. figures 5, 5a, 6; Plate II.

Pedunculi pedicellique fructigeri valde incrassati (usque 4 mm. crassi), rigidi, hi plerumque recurvi, apice expansi ; calyce plus minus persistente sepalis plerumque reflexis. *Capsula* bivalvis ; valvae maturae parvae, latissime hianti-patentes vel subreflexae, suborbiculares (sed incremento funicularum valde distortae), circiter 8 mm. diametro, tenuiter coriaceae, fragiles, siccitate fuscae ; *placentae* medianae, plerumque in pulvinam elongatam valde incrassatae ; *funiculi* e placentis horizontaliter vel patule exorti, 1–2 per valvam, adscendenti-curvati, valde incrassati, 2–3·5 cm. longi, 2 mm. crassi, saepe compresso-carinati vel striati, apice disciformiter expansi (4 mm. diametro). *Semen valde immaturum* depresse hemisphaericum vel potius semi-ovoïdeum, ala angustissima 1–2 mm. lata corrugato-undulata inclusa 12–17 mm. longum, 10–14 mm. latum, 5–7 mm. crassum, hilo in cavitate parva faciei plani (basalis vel ventralis !) sito, rhapha conspicua elevata in axi longiore seminis sita ; semen aetate paullo magis provecta 2·5–3 cm. diametro ala 4–6 mm. lata inclusa. *Semen maturum* summopere auctum, crasse discoidale, ala lata cinctum : corpus 4·5–5·5 cm. latum, 2–3 cm. crassum, facie basali (ventrali) depresse rotundata, hilo in depressione centrali (velut umbilico) sito, rhapha costam rotundatam conspicuam efformante, facie apicali (dorsali) leviter convexa varie rugulosa, rhapha

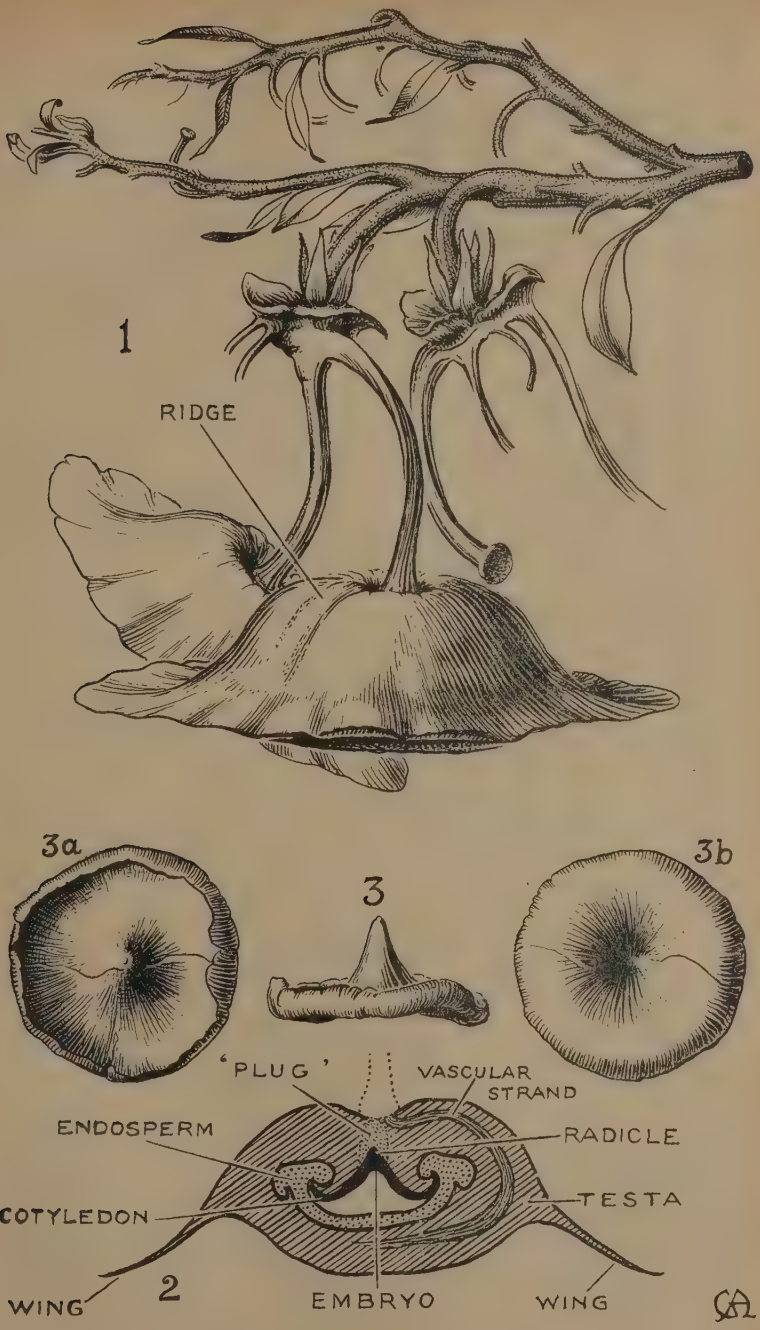


PLATE II. HABROPETALUM DAWEI (Hutch. et Dalz.) Airy Shaw.

Fig. 1, portion of infructescence with two 'fruits', showing persistent reflexed sepals, small 'collar' formed by the two more or less reflexed capsule-valves, and thickened placentas giving rise to about 4 funicles, not more than 2 of which in each 'fruit' bear fertile seeds; note conspicuous rhaphe ('ridge'); *nat. size*. 2, seed in longitudinal section (diagrammatic) in plane of rhaphe, *nat. size*. Note that the conical embryo is shaded solid black; the triangular white area below it represents an air-space. *Compare* 2, embryo in side view, showing recurved margins of cotyledons. × 2. 3a, embryo from

magis expansa sed minus conspicua usque ad medium discum fere attingente ; ala adscendenti-patula, 1·5–2·5 (–3) cm. lata, tenuiter striata, rigide et crasse coriacea, fragilis ; testa 5–7 mm. crassa, fere suberosa, sed dura, basi foramine micropylari (hilari) texto teneriore impleto ; *embryo* erectus, late obconicus, circiter 18 mm. diametro et 7 mm. longo, radiculo brevissimo foramini micropylari opposito, cotyledonibus latissimis semicircularibus lateraliter contiguis margine subrevolutis, plumulae vestigio nullo ; endospermum pileiforme, 3·2 cm. latum, 2–3 mm. crassum, periphero margine crasso duplici auctum : margine altero sub marginem cotyledonum inflexo, altero extrorsum reflexo, utroque rotundato.

The relatively dense-flowered, conspicuously bracteate inflorescence, the elongate valvate sepals, the large delicate petals, the two simple filiform styles with capitate stigmas, the small, bivalved, almost functionless ' capsule ', and the massive thick discoid seeds, borne on enormously thickened funicles, combine to render *Habropetalum* perhaps the most isolated and distinctive member of an already remarkable trio.

Mr. F. C. Deighton, of the Department of Agriculture, Sierra Leone, has kindly supplied the following information :—

" *H. dawei* is only so far known from three localities in Sierra Leone : Mosente (Kwako Krim Chiefdom), Mano Bonjema (Mano Sa Krim Chiefdom) and Juring (Gbema Chiefdom), all on the sandy coastal strip* in the south-east of the country, which includes a series of lakes and is a sort of lagoon formation (presumably once the sea-shore zone). Parallel sand beaches are very obvious in this area. It may well, therefore, be discovered near Fisherman's Lake (Robertsport), in the south-west of Liberia, which is, I think, the far eastern extension of this zone. The plant is abundant at Mano Bonjema and for a mile or two along the path westwards towards Boma, on the strip of sandy soil between Lake Mabesi and Lake Mape, scrambling over regrowth scrubby ' bush '. It is quite common just outside Juring, in regrowth scrub at the inner edge of the sandy coastal strip. In more open vegetation it will form a tangled bush on its own. The plant is very floriferous and showy in flower."

Mr. Deighton mentions that common ecological associates of *H. dawei* are *Ochna multiflora* DC., *Hymenocardia lyrata* Tul. and *H. heudelotii* Muell. Arg., and their hybrid (cf. Milne-Redhead, 1947).

" *Uses*. The stems of both species [*H. dawei* and *T. peltatum*] are used as rope for tying native house posts, etc. ; the split stem of *H. dawei* is locally regarded as a specially good rope for this purpose. The Kwako people are noted for a special high-quality piassava [*Raphia* spp.], and their custom is to tie up their piassava bundles with stems of *Dioncophyllum dawei* which they regard as a sort of trade-mark. They have recently [14.xii.49] been protesting against producers from further east (making piassava of a different quality) using *D. dawei* to tie up their piassava. The young pounded leaves of *H. dawei* are said to be used as a fish poison ; mixed with palm oil and applied to the affected foot, they are said to be very effective in killing jiggers.

" Vernacular names. Mende : *tawma* (*tawmei*) or sometimes *toma* (*tomai*). Krim : *sangi*."

*Extending for 40-50 miles, from about long. 12° W. to 11° 30′ W.

According to Grandidier (1934, t. XVII), the narrow sandy coastal strip is of Pleistocene age, and presumably of marine origin, though there is no evidence that any saline conditions exist there at the present time. The extremely restricted distribution of *Habropetalum* is very curious. As Mr. Deighton says, " the coastal area is not visited much, . . . but the plant is so conspicuous that it would certainly have been collected if it had occurred on Sherbro Island, at Shenge, and on the Colony shore, or between Freetown and French Guinea". It should also have been collected in Liberia if it occurred there.

The plant indeed bears many marks of being a relic of an earlier flora. The light though bulky seeds suggest an adaptation to dispersal by water, and Mr. Deighton states that in the wet season the sandy coastal belt where it occurs has a very high water-table and the whole area is more or less under water. At the present time, seed appears to be rarely set, for it has only twice been obtained*. The interior of the flowers seems to be very frequently damaged by some insect (possibly the larva of one of the Microlepidoptera), and this may be the main cause of sterility. It is to be hoped that detailed field observations on the bionomics of this interesting plant may before long become available.

Two non-pathogenic fungi, *Dictyopeltis* sp., very near to *D. consimilis* Syd., and *Clypeolum* sp., have been collected by Mr. Deighton on leaves of *H. Dawei*.

2. Dioncophyllum.

Dioncophyllum Baill. in *Bull. Soc. Linn. Paris*, [**2**], 870 (1890) ; Warb. in Engl. et Prantl, *Nat. Pflanzenf. III*, **6a,** 29–30 (1893) ; Gilg in Engl. *Bot. Jahrb.* **40,** 486 (1908) ; Sprague in *Bull. Misc. Inf.*, Kew, **1916,** 89–92 (1916) ; Gilg in Engl. *Nat. Pflanzenf.* ed. 2, **21,** 420–1, fig. 189 (1925) ; Hutch. et Dalz. *Fl. W. Trop. Afr.* **1** (1), 163–5 (1927) ; Lemée, *Dict. descr. syn. Genres Pl. phan.* **2,** 639 (1930), **5,** 1109 (1934), et **8b,** 422 (1943).

Sepala 5, parva, deltoïdea, in calycem parvum expansum breviter connata, aestivatione aperta. *Petala* 5, obovato-oblonga, sepalis multo longiora, subcoriacea. *Stamina* 10 vel circiter 25–30, filamentis elongatis aequilongis, antheris linearibus basifixis. *Ovarium* ovoïdeum, glabrum, primum ' synstylo ' brevissimo crasso terminatum, sed cito in valvas 5 liberas apice longe attenuatas solutum, quaque valva in stylum proprium elongatum desinente, stigmatibus minutis. *Ovula* serius describenda. *Fructus* maturus stellaris, valvis linearibus elongatis latissime patentibus. *Semina* tenuiter disciformia, ala latissima aureo-stramineo-nitida circumcincta.

Frutex alte scandens. *Caules* teretes, laeves, glabri. *Folia* alterna, oblongo-elliptica, petiolata, integra vel leviter crenulata, chartaceo-coriacea, crebre parallelo-nervosa, nervis angulum fere rectum cum costa efficientibus, margine plano, costa longe excurrente in uncos binos divaricatos abeunte. *Inflorescentia* cymosa, supra-axillaris, laxa, nuda, subcandelabriformis. *Flores* mediocres, longipedicellati, alabastro rotundati.

*By Paramount Chief Francis Fawundu, at Mano Bonjema ; transmitted to Dr. J. M. Dalziel at Kew by Mr. M. T. Dawe, 3 April 1926 ; and by Mr. F. C. Deighton, at Mosente (Kwako Krim Chiefdom), in March 1950.

PLATE III, DIONCOPHYLLUM THOLLONI Baill.

Fig. 1, flowering branch, *nat. size*. 2, flower-bud, × 3. 3, androecium from bud,showing arrangement of anthers, × 3. 4, gynoecium, × 3. 5, valve of ovary, showing arrangement of ovules, × 3. 6, ovule, × 30. 7, mature fruit, showing 5 spreading valves each bearing several funicles, and 2 seeds still attached, *nat. size*. 8, seed in basal (ventral) aspect, *nat. size*. 9, seed in longitudinal section (diagrammatic), *nat. size*. The very shallowly conical (almost discoid) embryo is shaded solid black ; the adjacent white area represents an air-space.

D. Tholloni Baill. *l.c.* ; Warb. *l.c.* ; Gilg, *l.c.* ; Sprague, *l.c.*, pro parte ; Gilg, *l.c.* ; Pellegrin in *Bull. Soc. Bot. Fr.* **80,** 233–6, c. fig. (1933).

French Equatorial Africa. Moyen Congo : Niari district, Comba (near Mindouli, c. 105 km. W. of Brazzaville), June 1888, *Thollon* 975 (type, in Herb. Paris.). Gabon : Haut-Ogooué, Lastoursville, 23 June 1930, *Le Testu* 8135 : " Liane. Fleur blanc jaunâtre. Etamines à filet groseille foncé, par 5 opposées aux pétales. Cirres doubles à l'extrémité des feuilles." *Ibid.*, Boucimbi, 19 Sept. 1930, *Le Testu* 8363.

Dioncophyllum Tholloni, the original species of the genus, differs from the other two principally in its elongate, open inflorescence, its usually (?) more numerous stamens, its five simple free styles, and its elongate, linear, rigid capsule-valves. The variation in stamen-number is noteworthy : Baillon found " un nombre indéfini " ; Gilg, " ∞ (etwa 27) " ; Le Testu (*in sched.*), 25, " par 5 opposées aux pétales " ; whilst the single flower that it was possible to examine for the present study had 10, clearly arranged (in the bud stage—see Pl. III, fig. 3) in two whorls of 5 each. It is hoped that more ample material may eventually become available in order to throw light on this point.

A detailed re-description of *D. Tholloni*, based on the type material, was published by Gilg (1908). The infructescence and seeds have been described and figured by Pellegrin (1933). The seeds are very similar to those of *Triphyophyllum peltatum* (*vide* p. 342 *ff.*, *infra*), not only outwardly but also in their internal structure : Compare Plate III, figs. 7-9, with Plate V.

I am indebted to M. Georges Le Testu for the following information concerning the habitat of this little-known plant. *D. Tholloni* is a liane of the high forest, spreading out in the canopy at a height of 30–40 m. The flowers are of course invisible from the ground, but, even allowing for this, it is probably a rare species, since in the course of 25 years' residence M. Le Testu only saw it on two or three occasions. In the Lastoursville area it occurred, at an altitude of 500–600 m., in very broken country intersected by innumerable streams ; the rock, frequently outcropping, consisted of granites, gneisses and schists. Geological maps of French Equatorial Africa (see Grandidier, 1934, t. XXII ; Legoux & Hourcq, 1943 ; Aubréville, 1948, p. 6) show both Lastoursville and the Niari region as lying on the ' Kundelungu ' formation, a system of calcareous or sandstone schists considered to be possibly of Upper Algonquian or Silurian age ; but whether this has any ecological or phytogeographical significance is doubtful. M. Le Testu states that the composition of the Congo forests is very imperfectly known, and that it would not be possible at present to distinguish special plant associations in them or to associate such with particular geological formations.

3. Triphyophyllum.

Triphyophyllum *Airy Shaw*, gen. nov., a *Dioncophyllo* Baill. foliis triformibus (unciferis in ramis primariis, simplicibus in ramulis brevibus axillaribus, linearibus glanduliferis vernatione circinatis in caulibus sterilibus novellis), venatione valde inconspicua, inflorescentiis brevibus paucifloris, staminibus 10 brevissimis, stylis ramosis, capsulae valvis parvis elliptico-oblanceolatis distinctum. (τριφύης, triformis, striplici naturae).

Sepala 5, parva, deltoïdea, in calycem parvum breviter aperte cupularem breviter connata, aestivatione omnino aperta. *Petala* 5, obovata, sepala multoties excedentia, textura crassa et subcoriacea, subcymbiformia. *Stamina* 10, brevissima, interdum circa basin capsulae persistentia, antheris oblongis. *Ovarium* obovoïdeum, cito in valvas 5 apertas dorso glanduloso-foveolatas secedens. *Styli* 5 (vel raro 3?), elongati, apicem versus in lacinias numerosas ± dichotomo-dissecti (cf. *Drosera* spp. !), papilloso-asperi, caduci. *Fructus* e valvis 5 parvis elliptico-lanceolatis patentibus sistens. *Semina* tenuiter disciformia, ala latissima stramineo-nitida circumcincta.

Frutex scandens, sed saepe in statu sterili vel immaturo vel reciso ut caules humiles foliosi erecti vigens. *Caules scandentes* teretes, laeves, glabri, ramellos abbreviatos foliosos axillares edentes. *Folia* alterna, triplicis generis : (1) ramorum elongatorum (scandentium) inter minora, anguste oblongo-elliptica, costa apice biuncifera, uncis saepe circinatis ; (2) ramellorum abbreviatorum majora, simpliciter oblongo-oblanceolata, uncis apicalibus nullis (vel rarissime evolutis) ; (3) in caulibus sterilibus (raro in ramellis abbreviatis) pauca ad costam solam partim vel omnino redacta, elongata, vernatione circinata, glandulis viscidis multis longe stipitatis (ut in *Drosophyllo lusitanico*) dense obsita ; lamina omnium plus minus coriacea, nervatione immersa inconspicua laxe elongato-reticulata in nervum tenuem submarginalem desinente, margine integra, plana, costa magis supra quam infra prominente, ima basi cum petiolo brevissimo persistente articulata. *Inflorescentiae* in ramellis abbreviatis ortae, parce cymosae, pauciflorae, minutissime rubido-furfuraceae, pedicellis elongatis, bracteis minutis. *Flores* iis *Dioncophylli Tholloni* similiores, alabastro rotundati.

Triphyophyllum peltatum (*Hutch. et Dalz.*) *Airy Shaw*, comb. nov.

Dioncophyllum peltatum Hutch. et Dalz. *Fl. W. Trop. Afr.* **1** (1), 163, 165 (1927), et in *Bull. Misc. Inf.*, Kew, **1928,** 31 (1928) ; Pellegr. in *Bull. Soc. Bot. Fr.* **80,** 234, 236 (1933) ; Dalz. *Usef. Pl. W. Trop. Afr.* 47 (1937) ; Metcalfe & Chalk, *Anat. Dicot.* **1,** 123 (1950).

[*Ouratea glomerata* (non *Monelasmum glomeratum* van Tiegh.) A. Chev. *Explor. Bot. Afr. Occ. Franç.* **1,** 108 (1920) ; Hutch. et Dalz. *l.c.* 195 (1927).]

Sierra Leone. Northern Province. Bombali District :—Near Makene (Bombali Sebora Chiefdom), in 2-year regrowth farm bush, 22 Feb. 1950, *Deighton* 5325 : "Climber with white flowers". Tonkolili District : Matotaka (Tane Chiefdom), 1914, *N. W. Thomas* 1287a. Southern Province. Moyamba District :—Newton (Colony), climber in cassava farm near stream, 16 Feb. 1949, *Deighton* 5001. Moyamba (Gandima Chiefdom), 31 March 1931, *Deighton* 1919, 1919A : "Common climber in forest. Flowers not seen. The specimens seen had been cutlassed and had straggly stems only a few feet long. When cutlassed, the plant often grows up as 1919A, with long narrow leaves with two rows of glandular hairs which are very viscid." Bagroo River (prob. Bagru Chiefdom), 1861, *Mann* 813. Bo District :—Near Bo (Kakua Chiefdom), 1936 (reported by *Deighton*). Kenema District :—Kenema (Nongowa Chiefdom), 20 Jan. (?1914), *N. W. Thomas* 7674 ; vernacular

PLATE IV, TRIPHYOPHYLLUM PELTATUM (Hutch. et Dalz.) Airy Shaw.

Fig. 1, flowering branch, showing hook-leaves subtending axillary short-shoots bearing hookless leaves and inflorescences (hook-leaf missing from short-shoot on left), *nat. size*. 1a, portion of lower surface of leaf, showing venation, × 2. 2, apex of young vegetative shoot bearing elongate hookless leaves and one gland-leaf with greatly reduced lamina, *nat. size*. 3, flower-bud, × 2. 4, flower with perianth removed, showing androecium and gynoecium, × 5. 5, very young fruit, showing young seeds developing on thickening funicles, × 2. 6, young seed, × 2. 7, mature seed, in basal (ventral) aspect, *nat. size*.

name, *bwatobi* (Mende). Pujehun District :—Pihalla (Kabonde Chiefdom), 1926, *Dawe* s.n. : " This plant is known as *tomai* here. It has been found that it grows better in the sandy region than in the interior." Kwaoma (Tunkia Chiefdom), 9 March 1945, and Lowoma (Nomo Chiefdom), 10 March 1945, *Deighton* s.n. : " Common climber. White flowers. Fls. rare." Zimi (Makpele Chiefdom), 6 May 1939, *Deighton* 3726 : " Climber. White flowers."—Without locality, 1914 (?), *Lane-Poole* 186 (type) : " Creeper 40–60 ft., 4 inches diam. at base, used to tie rafters of native houses " ; vernacular name, *tomai* (Mende).

Liberia. Western Province. Grand Cape Mount County :—R. Mano, 23 Dec. 1947, *J. T. Baldwin Jr.* 10809. Boporo District :—Ba, near boundary of Grand Cape Mount County, 18 Dec. 1947, *Baldwin* 10712. Tawata, 15 Nov. 1947, *Baldwin* 10333 : " Scandent." Beiden (?Bienden), 13 Nov. 1947, *Baldwin* 10270 : " Common throughout area." Montserrado County (?) :—Begwai Bush, Gola Forest, N. of Barway Town, forest floor, 25 Oct. 1910, *Bunting* 138 : " Flower unknown." Montserrado County :—Dukwia [Du] River, 26 Feb. 1929, *Cooper* 303 : " Vine used for elephantiasis and for women's pains in abdomen " ; vernacular name *goe-doo*. Salala District :—In dry woods near Monrovia–Gbarnga road and at boundary with Gbarnga Distr., 25 Jan. 1950, *Baldwin* 14045. Zienshu, in dry forest, 27 Feb. 1950, *Baldwin* 14178 : " Woody climber."—Central Province. Gbarnga District (?) :—Bonutah, in dry original forest in dense shade, 3 Oct. 1926, *J. Bequaert* for *Linder* 892 : " Flowers [sic !] small, in uncoiling fern-like spike. Plant later gives rise to vine with leaves armed with claws." Sanokwelle District :—Ganta, roadside, 300 m. alt., 4 July 1939, *Mrs. W. J. Harley* 1133 : " Vine over trees, 6 m. high, 1 cm. diam. ; leaves 15 × 4 cm., with indefinite lateral nerves, some with midrib prolonged in hooks. Fruit [sic] thin, circular, 6 cm. diam. Used for tying house-poles." Vernacular name, *ma bele*.—Eastern Province. Sinoe County :—Duo, common, 11 March 1948, *Baldwin* 11349. Tchien District :—Gletown, 29 July 1947, *Baldwin* 6923 : " To 2 feet." Webo District :—Jabroke (Palipo), 12 July 1947, *Baldwin* 6444.

Ivory Coast (extreme S.W.). Bassin du Moyen Cavally, rives de la rivière Hana, entre Fort Binger [Patokla] et le Mont Niénokoué, 17–18 July 1907, *Chevalier* 19518. Forêt de Taï, 7 Oct. 1949, *Jacques Miège*.

A description of the hitherto undescribed capsule, and amplified details of the seeds, are given herewith. (See also Pl. IV, fig. 5, Pl. V.)

Pedunculi pedicellique fructigeri haud vel vix incrassati. *Calyx* persistens, immutatus. *Capsula valde immatura* obovoïdea vel pyriformis, basi angustata, citissime in valvas 5 leviter hiantes vel patulas soluta ; valvae cymbiformes, acutae, dorso inconspicue carinatae, placentis medianis seriem seminum disciformium juniorum gerentes. *Capsula matura* patentim quinquevalvis (abortu interdum quadrivalvis), usque 4 cm. diametro ; valvae elliptico-oblongae vel interdum subspatulatae, 1·8–2·7 cm. longae, 7 mm. latae, acute apiculatae, dorso inferne leviter carinatae ; funiculi seminum fertilium (haud plura quam unum per valvam evoluta) angulo valde acuto e valva orti, patentes vel adscendentes, usque 5·5 cm. longi, 1 mm. crassi. *Semen maturum* latissime disciforme (interdum leviter cupuliforme ?), ala inclusa 4·5–7 cm. diametro, funiculae ut videtur angulo

PLATE V, TRIPHYOPHYLLUM PELTATUM (Hutch. et Dalz.) Airy Shaw.
Portion of branch with infructescence, showing 1 young and 2 mature fruits, and 3 mature seeds *in situ, nat. size.* Diagram shows central portion of seed in longitudinal section, × 4½. (Black=embryo ; white=air-space.)

acuto (oblique) nec angulo recto affixum ; corpus centrale parvum, 12–14 mm. diametro, depresso-hemisphaericum, facie basali convexa, facie apicali plana et leviter depressa, rhapha valde inconspicua ; ala pro rata latissima, plana, stramineo-nitens, valde nervoso-striata, margine crenulata, textura subpapyracea ; embryo disciformis, tenuis, 5–6 mm. diametro, margine reflexo, radicula papillam parvam centralem rotundatam efformante; endospermum pileiforme, embryonem amplectens, margine sub marginem cotyledonum revoluto.

The distinctive features of *Triphyophyllum* are its heteroclady, with clear differentiation into long and short shoots ; its extreme heterophylly—with three distinct types of leaf, each showing a considerable range of variation, and one of them representing a type for practical purposes otherwise unknown ; the relatively obscure, immersed venation, of a much laxer type than that of the other two genera ; the curiously articulating petiole, leaving a persistent peg on the stem after falling ;

the short, few-flowered inflorescence ; the very short stamens ; the branched, papillose styles ; and the leathery capsule-valves, intermediate in size between those of the other two genera.

Mr. F. C. Deighton sends the following notes of the occurrence of *T. peltatum* in Sierra Leone :—

" *T. peltatum* is a high forest species. It is a fairly common climber in the Gola Forest area in the south-east of Sierra Leone, and occurs sporadically in other forest areas. Plants do not flower abundantly, and often only one or two small panicles can be found in a dozen miles though plants may be seen every few hundred yards along the route. In cleared areas of forest, *T. peltatum* does not grow well : it is only happy when climbing over a shrub or tree. It appears to be widely distributed in regrowth forest and even locally common there, but I have seen no flowering specimens away from high forest. In regrowth forest the plant frequently occurs in the form with remarkable gland-leaves.

" *Uses*. The stems of both species [*T. peltatum* and *H. dawei*] are used as rope for tying native house posts, etc. . . . The root of *T. peltatum* is said to be purgative. It is, however, very poisonous in overdose : in 1936 a native man near Bo [Bo District, Kakua Chiefdom] died two hours after drinking a decoction of the root."

Vernacular names. Mende : as for *H. dawei* ; also *bwatobi*. Krim : probably as for *H. dawei*, if *T. peltatum* occurs in Krim country.

In Liberia, Cooper and Record (1931, p. 27) state that *T. peltatum* " has an important place in native medicine, the inner bark and leaves [being] beaten up fine and rubbed on parts of [the] body affected with elephantiasis, or made into hot poultices for abdominal pains." Mrs. Harley notes the employment of the stems for tying house-posts, as in Sierra Leone.

Vernacular names. Bassa : *goe-doo* ; Sanokwelle : *ma bele*.

Triphyophyllum peltatum probably occurs over the greater part of Sierra Leone and Liberia, and just reaches the south-western corner of the Ivory Coast. According to Grandidier (1934, t. XVII), most of this area consists of Archaean gneisses, while Cooper & Record (1931, p. 5) state that in Liberia the soil is mainly " a decomposed laterite mixed with gravel and clay ", the purplish-red colour being due to the presence of iron.

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Identification of Rhododendrons by microscopical characters.*

Although British taxonomists are gradually becoming less shy of using the compound microscope as an aid in the task of improving the classification of the flowering plants, the microscopical approach is still commonly regarded as a technique which should be adopted in the herbarium only as a last resort. The microscope is frequently looked upon by taxonomists mainly as a tool for counting chromosomes, whilst the range of diagnostic characters that lie between those that can be seen with a hand lens, and those that need to be observed with a twelfth objective fall into a lacuna into which but few deign to probe. It is, therefore, most encouraging that a taxonomist, so well known as Dr. Cowan, has, with financial assistance from the Carnegie Trustees, taken the important step of devoting a whole book to the epidermal appendages of the leaf in attempting to point out where improvements may be effected in the classification of the difficult genus *Rhododendron.* Some may argue that there is nothing new in this, and point out that the characters of the indumentum have for long been used in classifying Rhododendrons.

*The Rhododendron Leaf, a study of the epidermal appendages: by John Macqueen Cowan. pp. vi + 116 : London, Oliver and Boyd 1950, price 21/-.

There is some truth in this contention, but when one sees the thoroughness with which Dr. Cowan has done his work, and the greatly increased precision with which he has described and classified the different types of trichomes and scales, there can be no doubt that a real advance has been made. Another notable feature of the book is the elegant and convincing drawings of the various types of papillae and scales, prepared by Dr. E. M. Knox. There are also 12 coloured photographs by Mr. R. Eudall showing characteristic types of indumentum.

The text comprises 9 chapters, followed by a bibliography and an index to the species of *Rhododendron*. In chapter 1 the reader is introduced to the general features of the indumentum. In chapter 2 he is told that the purpose of the book is to suggest improvements in the classification of the genus drawn up in " The Species of Rhododendron ", which was published in 1930 by the Rhododendron Society. In the same chapter we are also introduced to the simple technique which the author adopted when making microscope slides. This was to remove a few trichomes with a scalpel from " the under side of the leaf at a point about midway between the midrib and the leaf margin ", float them out in methylated spirit, a drop of 50 per cent glycerine being added before examining them. Scales were examined *in situ*, as well as after being scraped off and mounted. Sections of the leaf were also prepared when necessary. Reference to previous work is made in chapter 3, special attention being devoted to the respective publications by De Bary, Vesque and Solereder. Here it is surprising to find no mention of the reference work entitled "Die Pflanzenhaare " by Netolitzky which was published in 1932. In chapters 4–6 we find careful descriptions of the epidermal appendages which are grouped in a number of distinct types. The basic distinction is between papillae, trichomes and scales respectively. The author breaks away from the system, adopted by Solereder and others, whereby glandular trichomes are contrasted with non-glandular types. Instead the basic distinction is between trichomes that are simple and unbranched, as opposed to those that are compound and branched. This change has much to commend it, not only for *Rhododendron* but in other Dicotyledons generally. In all, some 25 outstanding types of trichome are recognized. Scales are classified in five main groups, ranging from those that are entire, through those with crenulate, notched and scalloped margins, to vesicular or bladder-like forms. There is an analytical key to the species based on the indumentum characters.

In discussing the taxonomic value of the epidermal appendages in chapter 7, the author points out that, apart from dividing *Rhododendron* into 2 large sections, the characters of trichomes and scales serve to separate certain series or groups of series, and that trichome types may enable some of the species to be more accurately delimited. It is concluded that adjustments in the existing classification of the genus are needed. A discussion of the development of the trichome in chapter 8 leads to speculations concerning the phylogenetic interrelationships of the various types, and a possible sequence is shown by a diagram. The author warns us, however, that it would be wrong to suppose that any one type of trichome has been directly derived from another, or that one is more primitive than the next. He also emphasizes that complex and simple appendages are by no means confined to Rhododendrons that are

already generally accepted as advanced or primitive members of the genus respectively. The subject matter of chapter 9 is more physiological, and deals with the relationships between habitat and type of indumentum.

The reviewer has no special knowledge of the genus *Rhododendron*, and cannot, therefore, assess the merits of the author's suggestions for improving its classification. It is felt, however, that Dr. Cowan has performed a useful service in showing that careful attention to microscopical details are more worthy of the taxonomist's attention than is frequently realized, and it is to be hoped that his mode of investigation will be applied to other difficult groups.

C. R. METCALFE.

Comparative Embryogeny of the Gymnosperms and Angiosperms*—In a review article recently published in this journal (Kew Bull. No. 1, p. 140 : 1951) it was pointed out that no book dealing with the embryology of angiosperms had appeared in the English language for many years until Maheshwari's " Angiosperm Embryology " became available in 1950. Only a short time afterwards, Johansen's important book, which is now under review, was received from the publishers. It is to be hoped that the almost simultaneous appearance of these 2 books will arouse fresh interest in plant embryology, a subject which has received scant attention from British botanists in recent years. A detailed comparison of the 2 books would, however, be odious, and serve no useful purpose, since the 2 authors have different concepts of the precise meaning of the term " embryology ". Furthermore, whilst Maheshwari's book is concerned with the angiosperms, Johansen's deals with the gymnosperms as well. Johansen uses the term " embryology " in the sense that it refers to the development of the embryo from the fertilized egg cell, the changes involved being considered from both the morphological and physiological angles, although, in the book under review, he deals almost exclusively with the morphological aspects. The development of the ovule, microspores and megaspores, together with seedling anatomy, are held to be outside the purview of embryology in the strict sense.

The book begins with an historical introduction of 12 pages. This is followed by 14 chapters dealing with gymnosperms in 80 pages. The gymnosperms, not being regarded as a natural group, are covered under the headings Cycadophyta, Ginkgophyta, Coniferophyta and Ephedrophyta, of which the Coniferophyta are further divided into 10 groups ranging from Pinaceae to Taxaceae, whilst under Ephedrophyta, the Ephedraceae, Gnetaceae and Welwitschiaceae receive separate treatment. Pages 93–294 are concerned with the angiosperms in 6 chapters. These are entitled " General Considerations ", " Types and Variations ", " Special and Comparative Embryology ", " Apomictic Embryogeny ", " Adventitious Embryogeny" and " Polyembryony " respectively. The

*Plant Embryology. Embryogeny of the Spermatophyta by Donald Alexander Johansen. Waltham, Mass. : The Chronica Botanica Co. ; London, W.C.2. : Wm. Dawson and Sons Ltd., 1950. Pp. xvi + 305. $6 for memoir edition. $14 for special interleaved edition bound in half leather.

chapter on " Special and Comparative Embryology " will be found especially useful by angiosperm taxonomists, since, in it, the existing information is summarized under orders and families, thus enabling speedy reference to be made to any particular group. A point that will be regretted by taxonomists, particularly in this chapter, is that the names of species have been given without the authorities. Whilst this is perhaps not a great disadvantage at present, it may well cause difficulties to those who may consult the book in the future, when the names now in current use may have been superseded by others. The book ends with a useful " Glossary " followed by separate indexes to " Phyla, orders and families " and to " Genera and species ".

The author is a keen disciple of the French embryologist René Souèges, concerning whom he writes on p. 10 " The great tragedy of plant embryology, a serious indictment of most other workers, has been, and to a great extent still is, that so little attention was paid to the fundamental contributions of Souèges. During the third (historical) epoch only 3 embryologists—Bhaduri, Crété and Noll—attained the sublime and precise embryonic procedure established by Souèges ". It is not possible in this review to discuss Souèges' work in detail, but there can be no doubt that the author is right in drawing attention to the great skill and tenacity of purpose with which Souèges' little known work has been done.

Plant embryology, like systematic anatomy, has not yet reached a stage at which its full significance can be assessed, because so much more descriptive work will have to be undertaken before a clear picture of the subject as a whole can be obtained. The author, for example, points out that, although the embryology of about 145 families of Dicotyledons has been examined to some extent, the information about many of them is still very scanty. Only some 35 families of Monocotyledons have received attention. The gaps in our knowledge are particularly striking, for example, in a large family such as the Euphorbiaceae where the only genera that have been studied are *Euphorbia* and *Aleurites*. The author, nevertheless, draws attention to the similarity of the embryology of *Euphorbia* to that of the Ranunculaceae. One may well enquire whether such a resemblance is purely fortuitous, or whether further investigation will show the embryology of the 2 families to be significantly alike in other genera and species. In view of the enormous size of the family Euphorbiaceae, and the diversity of the component genera and species, it seems hardly likely that the embryology will be similar in all of them. Problems such as these should, however, serve as a stimulus to the few plant embryologists in the world to press on with their researches. How much more worth while a concentrated attack on major problems of this type would appear to be than are many of the scrappy, isolated investigations of comparatively small points that occupy so many skilled botanists at the present time. Dr. Johansen is to be commended for having marshalled the available information concerning plant embryology with such painstaking care, and it is to be hoped that his book will serve as a focal point around which further investigations will be initiated.

C. R. Metcalfe.

THE ANATOMICAL STRUCTURE OF THE DIONCOPHYLLACEAE IN RELATION TO THE TAXONOMIC AFFINITIES OF THE FAMILY.†

By C. R. Metcalfe.

The anatomical features of the vegetative organs confirm Mr. Airy Shaw's opinion that there is a remarkable similarity between the Dioncophyllaceae and the Nepenthaceae, and between the Dioncophyllaceae and the Droseraceae, whilst there is also a less marked resemblance to the Ancistrocladaceae. The similarity in exomorphic characters between the Dioncophyllaceae and *Kielmeyera* (family Guttiferae), as noted by Mr. Shaw, is not accompanied by anatomical resemblances, and, indeed, there are very notable differences in the structure of the 2 groups. Evidence of affinity between the Dioncophyllaceae and members of the Linaceae is very slender. An account of the anatomy of the genera concerned, with special emphasis on the salient features that are reliable as indicators of taxonomic affinity, is given below. The publication of this detailed description is desirable because the only previous account of the structure of the Dioncophyllaceae is the one given by Scott (*), which consists only of very brief notes. It will be seen from what follows that most of the facts recorded by Scott have been fully confirmed. It should, however, be remembered that, in her article, the term 'internal phloem' refers to the tissue that is now commonly known as interxylary phloem. Furthermore her statement that the 'stomata are surrounded by ordinary epidermal cells in no definite arrangement' is not strictly accurate.

In the present investigation, special attention has been directed to *Triphyophyllum peltatum*, of which herbarium material was examined, and *Habropetalum dawei*, of which spirit material and herbarium specimens were available. A very small fragment of the stem of *Dioncophyllum tholloni*, taken from a herbarium sheet, was also examined. The structure of all three species exhibited many features in common.

A. *Triphyophyllum peltatum.*

1. Leaf.

The leaves of this species are of 3 types. Those on the long shoots are typical assimilatory leaves bearing 2 hooks, in the form a crozier, at the distal end. The leaves on the axillary short shoots are similar but without hooks. The third type of leaf, which occurs on certain non-flowering shoots, has a very much reduced lamina, and, on the midrib, bears remarkable glandular hairs which are described in detail below. Field notes, made by collectors, imply that the shoots bearing the third, highly specialized, type of leaf most frequently arise on plants that have been mechanically injured, e.g. with a cutlass. In the present investigation no great attention was devoted to the structure of the hooks, and the following descriptions refer, therefore, to typical foliage leaves and gland-bearing leaves respectively.

†A sequel to Mr. Shaw's article on pp. 327-347.

*Scott, F. M. The anatomy of Dioncophyllum. Kew Bull. 92 ; 1916.

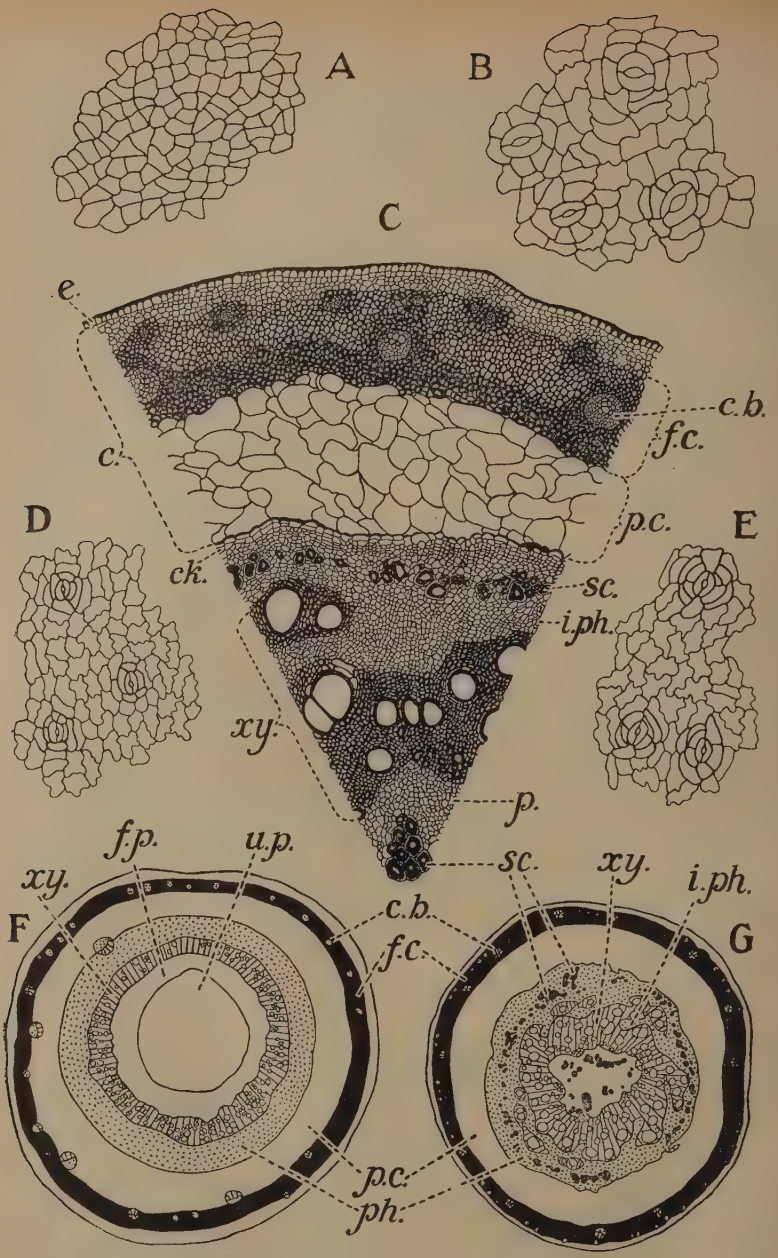

FIG. I.

A. *Triphyophyllum peltatum.* Upper epidermis of leaf × 200.
B. *Triphyophyllum peltatum.* Lower epidermis of leaf × 200.
C. *Triphyophyllum peltatum.* T.S. stem × 60.
D. *Habropetalum dawei.* Lower epidermis of leaf × 200.
E. *Habropetalum dawei.* Lower epidermis of leaf × 200.
F. *Nepenthes* sp. T.S. stem × 8.
G. *Triphyophyllum peltatum.* T.S. stem × 10.

c. cortex, c.b. cortical bundle, ck. cork, e. epidermis, f.c. fibrous portion of cortex, f.p. fibrous portion of pith, p.c. parenchymatous portion of cortex, ph. phloem, i. ph. interxylary phloem, sc. sclereids, u.p. unlignified pith, xy xylem.

(i). Foliage leaf. **Hairs.** None seen. **Epidermis.** Cells of the upper epidermis small, covered externally by a thick cuticle ; exhibiting, in surface view, fairly thick, almost straight, but sometimes slightly sinuous, anticlinal walls. (Fig. 1, A). Cells of the lower epidermis with thinner and more sinuous anticlinal walls. (Fig. 1, B). **Stomata** numerous, confined to the lower surface, many of them somewhat actinocytic (surrounded by a circle of subsidiary cells). **Hypoderm** in the form of a single layer of rather thick-walled cells, present below the upper epidermis. **Mesophyll.** Two or 3 layers of short palisade cells present below the hypoderm. Central part of the mesophyll consisting of large, thin-walled cells with no chloroplasts. Abaxial part of the mesophyll made up of a small-celled, spongy tissue, extending from below the large central cells to the lower epidermis. Vascular bundles of the **veins** embedded in the mesophyll, the smallest surrounded by large parenchymatous cells, those that are slightly larger partly or completely surrounded by fibres. **Midrib** with an approximately crescent-shaped vascular strand at the centre. Central vascular strand surrounded by a zone of about 4 layers of large parenchymatous cells, which are encircled by a continuous cylinder of sclerosed cells with fairly thick walls and wide circular lumina. A ring of about 18 small, almost or quite collateral, vascular strands, in which the phloem is usually more plentiful than the xylem, are embedded in the cylinder of sclerosed cells. The small vascular strands towards the abaxial side of the midrib are inversely orientated, whilst the orientation of those towards the adaxial surface is normal. **Petiole** (Fig. II, F), in transverse sections through the distal end, similar in structure to the midrib, but with 2 wing bundles.

(ii). Reduced leaves with glandular hairs. (Fig. III). In the specialized, gland-bearing leaves, now to be considered, the lamina is frequently so much reduced that the leaves might easily be mistaken for stem rather than foliar structures. That they are true leaves is, however, clearly indicated by the occurrence of forms in which the proximal portions are provided with flattened, wing-like expansions, as in a typical lamina, whilst the midrib is prolonged distally and bears stalked glands on all parts of the surface. In the most highly reduced leaves, little or no trace of the lamina remains, the organ then resembling a midrib bearing glands from the apex downwards for about three quarters of its length.

The **stalked glands,** some of which are branched and tufted, when cleared and examined under a low powered binocular microscope, show a superficial resemblance to the fructifications of an agaric. In the herbarium specimens examined, the heads of the glands were seen to be multicellular and composed of thin-walled cells filled with dense, apparently granular contents, the dome-shaped apex of the head being more transparent than the inner part. In the region where the apex of the stalk is united to the head of the gland, longitudinal sections reveal a single, conspicuous layer of cells with slightly thickened walls. (Fig. III B, a). In section, this layer of cells has the form of an inverted saucer, the concavity of which fits tightly over the thin-walled parenchyma of the stalk of the gland (Fig. III B, b). The head of the gland consists of thin-walled parenchymatous cells (Fig. III B, c). A vascular strand (Fig. III A, d), consisting of spirally thickened elements, extends

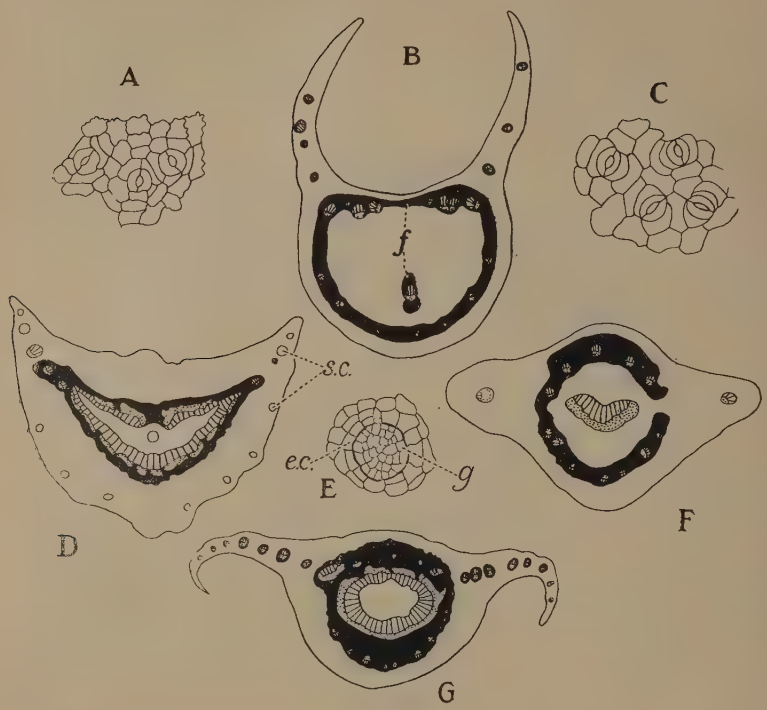

FIG. II.

A. *Ancistrocladus barteri* Scott Elliot.
Lower epidermis of leaf × 200.
B. *Nepenthes* sp. T.S. petiole × 20.
C. *Kielmeyera corymbosa* Mont. Epidermis of leaf × 200.
D. *Kielmeyera pumila* Pohl. T.S. petiole × 25.
E. *Ancistrocladus barteri.* Sunken gland in leaf surface × 200.
F. *Triphyophyllum peltatum.* T.S. petiole × 35.
G. *Ancistrocladus barteri.* T.S. leaf base × 20.
e.c. epidermal cells surrounding a gland, f. fibres, g. head of gland in surface view, s.c. secretory cavities ; phloem as dotted areas ; xylem as areas with straight lines ; sclerosed tissue solid black.

throughout the length of each stalk (which otherwise consists of thin-walled parenchyma), and divides into a number of smaller strands just below the union between the head and stalk of the gland (Fig. III A, e), the ends of the small strands then radiating towards the periphery of the glandular head. The distal ends of the vascular strands consist of enlarged elements with scalariform to reticulate pitting (Fig. III C). At the bases of the stalks, the vascular strands pass obliquely into the foliar organ on which the glands are borne and there unite with the vascular system of the midrib (Fig. III A, f). The appearance of transverse sections through the gland-bearing portion of the midrib varies somewhat according to the level at which the sections are taken. In a typical section there is a relatively large, somewhat flattened vascular strand at the centre, surrounded by a peripheral ring of much smaller bundles of

which 2 are illustrated (Fig. III B, g). The peripheral bundles arise as branches from the central vascular strand, and in some transverse sections, branches from the central strand are to be seen passing outwards to become part of the peripheral ring. The bundles bifurcate as they pass outwards and upwards, and become progressively smaller in diameter at each succeeding bifurcation. This forking sometimes occurs between the central bundle and the peripheral ring, or it may take place in the peripheral ring itself. It follows that, as a result of this method of branching, the longer-stalked more mature glands are united to the central vascular system of the midrib by bundles that are wider in diameter than the vascular ' traces ' to the smaller, and apparently immature, shortly-stalked glands. The finest branches of the vascular system are so small that they each include only one or a very few spirally thickened elements (Fig. III B, h). It was not possible, with the limited material available, to determine whether the finest vascular branches end blindly in the parenchyma, but it seems probable that they do so. It may be that additional glands are formed during subsequent elongation of the midrib, and that the finest branches of the vascular system then become enlarged and serve to supply the newly formed glands.

The stalked glands are of particular interest when compared with the ' tentacles ' of the Droseraceae to which they bear a strong resemblance in their general morphology. The occurrence of vascular strands in the stalks of the glands is especially noteworthy, as vascularized hairs are known in only a very few families of Dicotyledons.

Multicellular, **sessile glands** also occur in *Triphyophyllum* amongst those that have stalks. Their structure is not unlike that of the digestive glands on the leaf of *Nepenthes*.

2. Stem.

(Description based on herbarium specimens about 0·5 cm. in diameter). Fig. I, C and G).

Epidermis composed of small cells. **Cortex,** apart from about 3 layers of small parenchymatous cells immediately below the epidermis, very clearly differentiated into 2 zones of about equal width, the outer zone consisting of very thick-walled, pitted fibres with wide lumina (Fig. I, C, f.c), the inner zone being composed of large, thin-walled parenchymatous cells (p.c.). Cells of the fibrous zone up to about 24μ in diameter ; cells of the inner cortical zone 100–180μ in diameter. Numerous, irregularly distributed, inversely orientated, collateral, vascular bundles are embedded in the fibrous zone in the outer part of the cortex (c.b.). **Cork** (ck). Early stages in the formation of cork noted in the pericyclic region, many of the cork cells, which are fairly thin-walled, becoming filled with brown contents. **Phloem** (ph.) made up of somewhat elongated, thin-walled parenchyma cells and sieve tubes, the latter with large conspicuous sieve plates in the oblique end walls of the sieve-tube elements. A very much interrupted ring of conspicuous, curiously shaped, but frequently axially elongated, sclereids (sc.) with very thick walls, present in the phloem. Some sclerosed cells solitary, but others united to form small groups or clusters; lumina of the cells sometimes filled with a brown deposit resembling that in the cork cells. **Xylem**

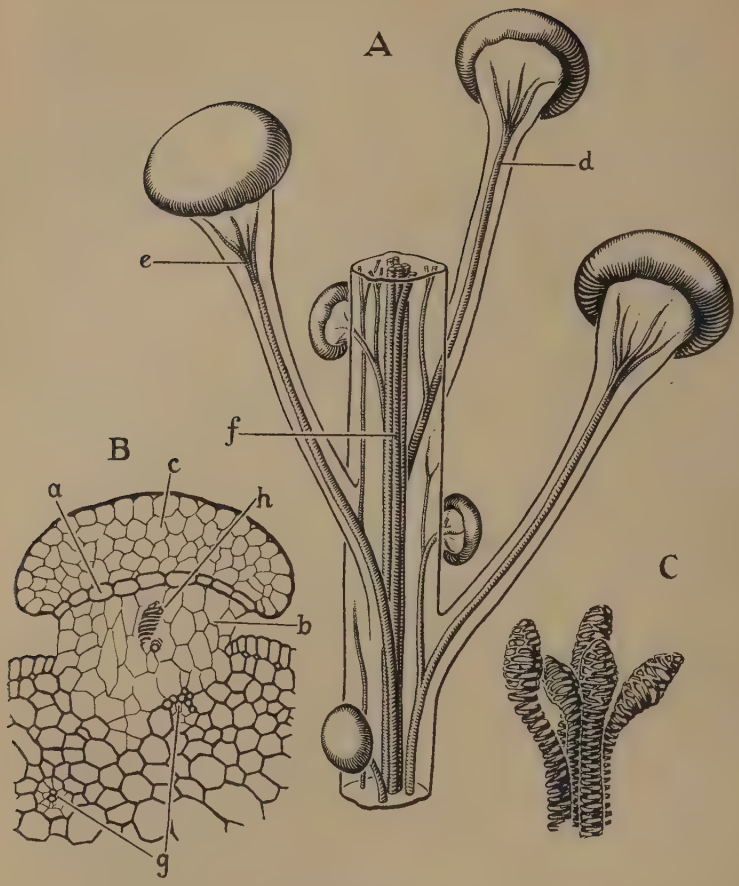

FIG. III.

Triphyophyllum Peltatum.

A. Distal end of the midrib of a reduced leaf bearing stalked glands. × 20.

B. Portion of a transverse section of a midrib passing through a young gland which is cut longitudinally. × 165.

C. Tracheal elements from the distal end of a vascular strand in the head of a gland. × 500.

a. Layer of cells with thickened walls. b. Thin-walled parenchyma in the stalk of a young gland. c. Thin-walled paranchyma in the head of a young gland. d. Vascular strand in the stalk of a mature gland. e. Position where the vascular strand divides into fine distal branches. f. Main vascular strand of the midrib. g. Small vascular strands in the peripheral part of the midrib. h. Terminal tracheal elements with spiral thickening.

(xy) in transverse sections, appearing very irregular in outline and somewhat dissected by areas of thin-walled, unlignified tissue (i.ph). Vessels of the primary xylem arranged in small crowded clusters ; very small, seldom more than 60μ in radial diameter. The following features are typical of the secondary xylem of small stems. Vessels medium-sized, wider elements mostly 165–180μ, but occasionally as much as 210μ, in

radial diameter ; mostly solitary, but oblique or radial pairs also occur. Vessel members 150–300μ long. Pits in the lateral walls of the vessels large, mostly opposite but tending to be alternate, with horizontal, slit-shaped, frequently coalescent apertures. Pits rather sparse in the wider vessels. End walls of the vessel members transverse to slightly oblique, with simple perforations. A few vessels with spiral thickening also noted besides those in the primary xylem. Fibres moderately thick-walled, with conspicuously bordered pits in all the walls. These elements constitute the ground-tissue of the xylem, except where it is interrupted locally by unlignified, thin-walled tissue extending into the xylem from the phloem. Here and there a few vessels, always surrounded by a few thick-walled fibres, become entirely surrounded by thin-walled ground-tissue. The unlignified regions of the ground-tissue (i.ph) undoubtedly represent the ' internal phloem ' mentioned by Sprague and Scott (*). The mode of development of this anmalous structure is discussed more fully below. Rays uniseriate, inconspicuous, curving around the vessels. **Pith** (p.) somewhat disorganized in the materal examined ; composed mainly of parenchyma, but including a considerable number of sclereids resembling those in the phloem.

The following notes on the structure of the wood in thick stems were kindly supplied by Dr. L. Chalk, of the Imperial Forestry Institute, Oxford.

Vessels very large, mean tangential diameter about 300μ ; mostly solitary, but with some irregularly orientated multiples of 2 cells ; about 2 per sq. mm. ; perforations exclusively simple ; intervascular pitting alternate, large and often with coalescent apertures ; pits to parenchyma cells similar. Members moderately short, mean length about 330μ. **Parenchyma** (a) Paratracheal, as narrow, vasicentric sheaths round the vessels ; and (b) apotracheal, as a few cells scattered among the fibres (diffuse) ; (c) conjunctive, between the bundles ; containing large solitary, and often spindle-shaped stone cells. **Rays** (a) Uniseriate and rather few ; short to moderately high ; composed almost entirely of square to upright cells ; continuing through the phloem bundles ; (b) multiseriate, interfascicular rays ; often containing large crystals. **Fibre-tracheids** with large, conspicuously bordered pits, which are equally numerous on both radial and tangential walls ; moderately short, mean length about 730μ. **Vasicentric tracheids** present, with very numerous bordered pits and a mean length of about 500μ, but not sharply defined from the shorter fibre-tracheids. **Interxylary** (included) **phloem.** The stem consists of a succession of irregularly mixed bundles of xylem and phloem.

Variations in Structure.

Whilst the description given above refers to typical flowering specimens of *Triphyophyllum peltatum*, the structure of specimens with gland-bearing leaves was found to differ in certain respects. Thus, in the leaf, no hypoderm was clearly differentiated below the upper epidermis, whilst the assimilatory tissue consisted mostly of small cubical, rather than of

*Sprague, T. A. Dioncophyllum. Kew Bull. 89–92 ; 1916.
Scott, F. M. The anatomy of Dioncophyllum. Kew Bull. 92 ; 1916.

palisade, cells, and the large colourless spongy cells occupied all of the space between the adaxial assimilatory tissue and the lower epidermis. Another notable difference was that none of the vascular bundles in the fibrous cylinder of the midrib showed completely inverse orientation. In comparing the stem of a gland-bearing specimen with that of a typical flowering shoot of about the same diameter (0·5 cm.), it was noted that, in the former, sclerosed cells were less numerous in the phloem, whilst the radial diameter of the vessels was usually about 75μ and seldom exceeding 90μ. The ground-tissue of the xylem, unlike that of a normal flowering shoot, was found to consist almost wholly of fibres, whilst unlignified ground-tissue was almost completely absent from some specimens, although sporadic patches were observed in others e.g. Lindner 892. Large prismatic and solitary cubical crystals, as well as occasional rosettes made up of large components, were observed, especially in the pith, in the stem of gland-bearing shoots. Most of the crystals in the pith were situated in, or closely associated with, the sclerosed cells. Starch was abundant in the phloem.

B. *Habropetalum dawei.*

The structure of the stem and leaf of this species is in many ways similar to that of the corresponding portions of *Triphyophyllum*. It is, therefore, unnecessary to describe the species in detail, but a brief comparison of the 2 species is given below.

1. Leaf.

The **stomata** (Fig. I, D and E), like those of *Triphyophyllum*, tend to be actinocytic, although the surrounding circle of subsidiary cells is not always very well defined. Another point of similarity between the 2 genera is that the centre of the **mesophyll** is occupied by large, colourless, spongy, parenchmatous cells, but, in *Habropetalum*, the small assimilatory cells do not form a well defined palisade tissue. It is noteworthy that, in *Habropetalum*, there are abundant solitary **crystals** in the parenchymatous cells accompanying the smaller vascular bundles. The structure of the **petiole** of *Habropetalum*, in transverse sections through the distal end, is very similar to that of *Triphyophyllum* except that the central vascular arc is replaced by a group of 3 distinct, but closely placed, collateral bundles. A circle of peripheral vascular strands occurs in both genera, but whereas the peripheral strands in *Triphyophyllum* are embedded in a homogeneous fibrous tissue, those of *Habropetalum* are in a heterogeneous tissue that is mainly fibrous but also includes a network of small parenchymatous cells. The fibres in *Habropetalum* have infrequent, inconspicuously bordered pits in their moderately thick walls, whilst the diameter of the lumina considerably exceeds the thickness of the walls.

2. Stem.

Numerous **glandular hairs,** with uniseriate stalks consisting of up to 4 cells and bearing flattened, multicellular heads, noted on the surface of young stems. The structure of the hairs could not be observed very accurately in the material available. As in *Triphyophyllum*, the **cortex** is differentiated into outer fibrous and inner parenchymatous portions, inversely orientated vascular bundles being embedded amongst the fibres. The thick-walled elements of the outer cortex were mostly about

20μ, but some up to 44μ or even more, in diameter. These contrasted sharply with the thin-walled cells of the inner cortex up to 200μ or more in diameter. When the fibrous zone was examined in material preserved in spirit, it appeared to be somewhat heterogeneous owing to the presence, amongst the fibres, of an irregular network of small parenchymatous cells with granular contents. These small cells were not immediately apparent in the herbarium material examined, because they become disorganized ; remnants of them could, however, sometimes be seen. The inner zone of the cortex, and also the pith, were likewise seen to be heterogeneous when spirit material was examined, because a network of relatively small cells with dense contents was present amongst the much larger parenchymatous cells of which the inner cortex and pith are mainly composed. The smaller cells tend to become disorganized in herbarium specimens, thus giving the inner cortex a more spongy appearance than it probably possesses in living stems.

The vessels of the primary **xylem** were mostly about 45μ in radial diameter, and usually arranged in radial multiples of up to about 5 cells. The vessels of the secondary xylem were up to about 120μ in radial diameter, mostly solitary, but some in oblique or tangential pairs. Tangential or oblique multiples of up to about 6 cells occasional. Vessel members 150–330μ long or occasionally rather more. Somewhat elongated, prismatic **crystals** were noted in the phloem and pith. The stem, like that of *Triphyophyllum*, exhibited anomalous secondary thickening.

C. *Dioncophyllum tholloni*.

Only a minute fragment of the stem of a herbarium specimen of this species was available. This showed that the structure resembled that of *Habropetalum* and *Triphyophyllum*, but the material was too immature and badly preserved to determine whether *D. tholloni* shows anomalous secondary thickening.

The anomalous secondary thickening.

The bulk of the available material was unsuitable for studying the anomalous secondary thickening in detail, because the cambium and other incompletely differentiated tissues had collapsed or were disorganized. It was, however, possible to follow stages in the development of the anomaly more closely in *Habropetalum dawei*, because spirit material, as well as herbarium specimens, were available. Sections of young stems of this species, cut only a short distance below the apical growing point, revealed the following structure. The 3 or 4 layers of subepidermal parenchyma constitute a clearly defined zone which is sharply demarcated from the portion of the cortex that ultimately becomes fibrous. The young fibrous cells are narrow and not appreciably thick-walled at this stage, although evidence of incipient thickening was noted. The fibrous zone is, however, already sharply differentiated from the inner parenchymatous zone of the cortex, the latter being partly composed of much larger cells, but, at the same time, appearing somewhat heterogeneous because it includes a proportion of cells that are distinctly smaller than the remainder. Intercellular spaces are poorly developed in the inner cortex at this stage. Inversely orientated bundles were already present in the outer part of the cortex.

From the inner boundary of the cortex a broad but sinuous zone of thin-walled cells extends inwards to the pith. This zone of tissue, which subsequently becomes differentiated into the 'pericycle', phloem and xylem, at this stage includes some rather ill-defined vascular bundles, of which the ground-tissue is similar in appearance to, and not distinctly differentiated from, the interfascicular tissue. The position of the xylem was seen to be clearly marked by a number of isolated vessels with spirally thickened, lignified walls. Other, incompletely differentiated vessels could also be seen. No continuous zone of cambium was observed, although short arcs of meristematic tissue were visible in the larger vascular bundles, and there was evidence of irregular cell divisions in some of the cells in the ground-tissue, both externally and internally to the xylem. At this same young stage the stellate pith consisted of cells resembling those in the inner part of the cortex.

Examination of stems of various ages showed that secondary thickening probably takes place in the following manner. The vascular tissue is wholly derived from the broad zone of small cells between the cortex and the pith. The primary vascular bundles arise in this tissue, where they are formed from axial columns of meristematic cells that divide in various planes. In the specimens actually examined, the vascular strands were at first arranged in 2 irregular concentric rings, with undifferentiated ground-tissue between them. Fascicular cambium which arises in some of the vascular bundles of the outer ring, subsequently becomes united by interfascicular cambium to form long arcs of meristematic tissue, by the activity of which the originally separate bundles become converted to long bands of xylem. Additional arcs of cambium arise in the ground-tissue immediately outside the pith, and also between the inner and outer rings of bundles. These cambia appear to increase the bulk of the ground-tissue, and also, here and there to give rise to additional vascular tissue. The apparently sporadic arrangement of the cambia, and the irregular manner in which they sometimes give rise to ground-tissue and sometimes to conducting elements, determine the complex structure of the wood in the young stem. The cambial arcs in the inner part of the ground-tissue gradually lose their activity, and subsequent growth in thickness takes place from long arcs of cambium at the outer periphery of the xylem. Eventually a deep-seated phellogen is formed in the 'pericyclic' region, where it gives rise to cork cells. After this the whole of the cortex falls off, the cork becoming the outermost layer of the stem.

The mode of origin of the anomalous structure in *Triphyophyllum* could not be followed in detail, as only herbarium material was available, and from this it was impossible to take sufficient sections for a developmental investigation to be made without seriously damaging the specimens. It seems probable, however, that the anomalous structure arises in a similar manner to that in *Habropetalum*, although there were indications that the arcs of cambium were rather shorter in *Triphyophyllum*. It frequently looked as if the phellogen gave rise to phelloderm as well as cork, and it seemed probable that arcs of cambium arise sporadically both in the phelloderm and in the subjacent parenchyma ('pericyclic' and phloem regions). It was noteworthy that in a slide of the fully matured wood (Imperial Forestry Institute 4688) stone cells, resembling those in the

' pericycle ', were visible in the unlignified ground-tissue. If, as seems probable, the greater part of the secondary xylem in this species is formed from phelloderm cells, the sclerosed elements in the ' pericyclic ' and phloem regions would tend to become embedded in the secondary xylem in consequence of the peculiar method by which growth in thickness takes place. The cambial arcs give rise to additional unlignified tissue as well as to typical xylem, and the extent to which the xylem is broken up by unlignified tissue appears to depend on whether the cambial derivatives remain unlignified or develop into typical xylem. Further examination of well perserved material is most desirable before the precise method by which growth in thickness takes place can be fully understood.

Comparsion of the Dioncophyllaceae with other genera.

Since the affinities of the Dioncophyllaceae have not hitherto been well established, it was hoped that the anatomical features might be used to throw further light on the taxonomic position of the family. At the suggestion of Mr. Airy Shaw comparisons were made with members of the following genera. (i) *Drosophyllum* and *Drosera* (Droseraceae). (ii) *Nepenthes* (Nepenthaceae). (iii). *Ancistrocladus* (Ancistrocladaceae). (iv). *Ctenolophon*, *Ixonanthes* and *Ochthocosmus* (Linacae). (v). *Kielmeyera* (Guttiferae).

(i). *Drosophyllum and Drosera.*

In comparing the structure of the Dioncophyllaceae with that of *Drosophyllum* and *Drosera* there is the immediate and obvious difficulty that *Dioncophyllum* and its allies, with their woody habit and scandent growth, must inevitably be very different in structure from the tallest of the very dwarf shrubs in *Drosophyllum*, and still more from the herbs of which *Drosera* is comprised. In spite of these differences, it is particularly noteworthy that the familiar ' tentacles ' or stalked glandular hairs of *Drosophyllum* are remarkably similar to those that occur on the gland-bearing leaves of *Triphyophyllum*. Attention was drawn to this similarity many years ago by Mr. L. A. Boodle. Similarity of hair structure cannot, however, by itself, do more than provide confirmatory evidence of affinity, because the same types are known to occur in many families between which there are no recognized close relationships. In making the present comparison, it should, therefore, be borne in mind that the glandular ' tentacles ' of the Droseraceae exhibit a very special type of structure which is of very restricted occurrence amongst the Dicotyledons. One of the most salient peculiarities is that their stalks are traversed longitudinally by axile strands of fine tracheae that terminate in enlarged groups in the head of the gland, whilst, at the proximal end of the stalk, the tracheae extend into the leaf, with the vascular system of which they are in direct connection. In the glandular hairs of *Triphyophyllum* there is a similar axile system of tracheids, but these are branched where the head of each gland joins its stalk, the small branches radiating towards the periphery of the glandular head. The stalked glands of *Triphyophyllum* are also appreciably larger than those of *Drosophyllum*, and the shape of the head is not quite the same in the two genera. These small differences are, however, insignificant compared with the remarkable general similarity in the vascular structure of the glandular hairs

in the two genera. Another point of similarity is the occurrence, in both *Drosophyllum* and *Triphyophyllum*, of the dome-shaped, sessile, multicellular glands amongst the stalked tentacles just described.

It must be emphasised that the similarity in hair structure is one of the very few points of resemblance between the Droseraceae and *Triphyophyllum*. The homogeneous spongy mesophyll of the Droseraceae is very unlike that of the Dioncophyllaceae, whilst the vascular systems of the petiole and leaf base in the two families are of very different types. The vascular structure of the scape of the Droseraceae is also very different from that of the stem of members of the Dioncophyllaceae. In *Drosophyllum lusitanicum* Link, the scape, in transverse section, exhibits a circle of small, widely spaced vascular bundles, situated at the inner periphery of a layer of cortical chlorenchyma. In addition there is a more deeply situated circle of 3 vascular bundles separated from those of the outer ring by a broad zone of collenchyma. The scape of *Drosera rotundifolia* is again somewhat different, since there is but one ring of vascular strands, and these are mostly centric in structure with central phloem.

The base of the stem of *Drosophyllum* is somewhat woody, but the wood structure shows little in common with that of the Dioncophyllaceae apart from the fact that the ground-tissue consists of fibres with conspicuously bordered pits (fibre-tracheids). This character is, however, of phylogenetic rather than taxonomic interest, fibre-tracheids being regarded as an unspecialized or primitive characteristic.

(ii) *Nepenthaceae and Dioncophyllaceae.*

In *Nepenthes* the leaf bears no ' tentacles ' comparable with those of the Droseraceae, but it is provided with multicellular glands, that vary in shape, and in the extent to which they are sunk below the epidermis, according to their position in the leaf and the species concerned. Sometimes the glands are partly covered over by epidermal tissue. These glands are not wholly unlike the sessile glands of the Droseraceae, and, as will be shown later, they somewhat recall the sunken glands of *Ancistrocladus*. Other features of the assimilatory portions of the leaf of *Nepenthes* are the hypoderm that is differentiated below the upper epidermis in some species, whilst most of the mesophyll consists of spongy tissue, the palisade cells being very short. The vascular bundles are embedded in the mesophyll.

The ' petiole ' of the leaf of *Nepenthes*, in transverse sections immediately below the ' lamina ', exhibits a peripheral ring of fibres with vascular bundles embedded in it. This is separated, by somewhat loose parenchyma, from one or a few collateral vascular bundles in the centre of the petiole. A broad survey of the petioles of the Dicotyledons shows that this type of vascular structure is unusual, and it is, therefore, interesting that peripheral rings of vascular bundles embedded in fibres occur in both the Dioncophyllaceae and Ancistrocladaceae, as well as in the Nepenthaceae. It should be noted, however, that the 1 or 2 relatively small, collateral vascular strands at the centre of the petiole of *Nepenthes* are replaced by an arc of xylem and phloem in the corresponding position in *Triphyophyllum*, and in *Habropetalum*, by 3 separate, but closely placed, strands. In this respect, therefore, the petiolar structure of *Habropetalum* resembles that of *Nepenthes* more closely than does the petiole of *Triphyo-*

phyllum. In the corresponding region of the petiole of *Ancistrocladus*, there is a central mass of xylem almost surrounded by phloem.

If a stem of *Nepenthes* (Fig. I. F) about 0·8 cm. in diameter is compared with a similar stem of any member of the Dioncophyllaceae, some very interesting resemblances are to be seen. Thus, as in the Dioncophyllaceae, the primary cortex is differentiated into two concentric zones of approximately equal width, the outer zone (f.c) of thick-walled, fibrous elements being in marked contrast to the much larger, thin-walled cells of the inner part of the cortex (p.c.). The Nepenthaceae also resemble the Dioncophyllaceae in having numerous small vascular bundles (c.b.) embedded in the outer, fibrous zone of the cortex. It is noteworthy, however, that the peripheral bundles of *Nepenthes* are normally orientated, with xylem towards the centre of the stem, whereas those of the Dioncophyllaceae are inversely orientated, the xylem being outwardly directed. Apart from the peripheral bundles in the cortex, the main part of the vascular system in *Nepenthes* consists of continuous cylinders of xylem and phloem traversed by narrow rays, and no evidence of anomalous secondary thickening has been recorded in the family. The xylem vessels are mostly solitary, with a radial diameter of up to about 150μ ; the vessel members being 165–300μ long. The ground-tissue of the xylem is composed of fibres with bordered pits. The vessels are, therefore, rather narrower and the vessel members somewhat longer than those of the Dioncophyllaceae, but the ground-tissue of the xylem, in both families, consists of fibres with conspicuously bordered pits. It is well known that peculiar, spirally-thickened elements resembling tracheids are very characteristic of *Nepenthes*, where they occur especially in the cortex and ' pericycle '. No such elements could be found in the corresponding tissues of the Dioncophyllaceae. *Nepenthes* also differs from the Dioncophyllaceae in having no stone cells or fibres in the ' pericyclic ' region or phloem.

The above facts show that, although there are conspicuous differences between the Nepenthaceae and Dioncophyllaceae, there are also quite notable resemblances, particularly in the vascular system of the stem and petiole, and in the occurrence of external glands that are rather similar in type.

(iii). *Dioncophyllaceae and Ancistrocladaceae.*

Ancistrocladus is a genus of scandent shrubs with a habit not unlike that of Dioncophyllaceae. A comparison of the 2 families was undertaken when it was noted that hooks resembling croziers occur in both. As already noted, those in the Dioncophyllaceae are essentially leaf structures and are borne at the apical ends of the foliage leaves. The hooks of *Ancistrocladus*, on the other hand, although very similar in external appearance to those of the Dioncophyllaceae, are stem structures. Apart from the similarity in the general appearance of the hooks, there are some interesting anatomical resemblances between the 2 families, particularly in the structure of the petiole. Since no account of the structure of the Ancistrocladaceae has been published in recent years, the following description, based on material in the Kew herbarium is given below. The structure of *Ancistrocladus barteri* Scott Elliot (Deighton 3885) is first described in detail, after which points of difference from other species are recorded.

1. Leaf of *A. barteri*.

Surface of the leaf covered with peltate, multicellular **glands** (Fig. II, E), sunk in the epidermis so that their heads fit tightly into depressions. **Epidermis** (Fig. II, A). Cells on the upper surface small, cubical with sinuous anticlinal walls. Cells of the lower epidermis also with sinuous anticlinal walls. **Stomata** numerous, confined to the lower surface ; many of them antinocytic, i.e. surrounded by a circle of more or less clearly defined subsidiary cells. A single layer of **hypoderm** present below the upper epidermis. This is in the form of continuous plates of elongated fibrous cells lying parallel to the surface of the leaf. The fibres are continuous with those associated with the vascular bundles of the larger veins. In surface view, the fibrous plates can be seen below the upper epidermis, the ends of the fibres terminating abruptly where they come in contact with the cells surrounding the depressed glands, thus making the fibres appear to radiate from around the glands. **Mesophyll.** One definite layer of palisade cells present below the hypoderm, followed, towards the inside of the leaf, by several layers of less tall assimilatory cells. Most of the mesophyll is composed of a spongy tissue of large colourless cells extending from the adaxial assimilatory cells almost to, but separated by small assimilatory cells from, the lower epidermis. Vascular bundles of the smaller **veins** embedded in the mesophyll and sheathed by large parenchymatous cells. Larger vascular bundles vertically transcurrent by thick-walled fibres, a few cubical crystals present in the cells bordering on the vascular bundles. **Midrib** with a cylinder of xylem enclosing a central pith-like tissue, the latter being made up of pitted cells similar to those in the pith of the stem. Xylem almost completely surrounded by phloem, the latter, in turn, being surrounded by a sheath of thick-walled fibres with minute vascular strands embedded in it. Two additional xylem strands, embedded in the phloem on the adaxial side of the central xylem, are situated on the inner side of the ring of fibres. **Petiole** (Fig. II, G) in transverse sections through the distal end, exhibiting an arc of xylem almost or completely encircling a central tissue of thick-walled cells. The xylem is surrounded by a narrow cylinder of phloem, which, in turn, is encircled by a cylinder of thick-walled fibres with small vascular bundles embedded in it.

Points of difference from the above description noted in other species were as follows.

Ancistrocladus extensus Wall. (Lace 4595).

Anticlinal walls of the cells of the upper epidermis almost as sinuous as those of the lower epidermis. Hypodermal fibres mostly confined to regions immediately above the vascular bundles, thus appearing to form a network with wide meshes when seen in surface view. Crystals more numerous in cells surrounding the vascular bundles. Vascular bundles in the fibrous ring in the midrib very small and inconspicuous, tending to become decomposed in herbarium material, and then leaving small channels that could be mistaken for canals. Main xylem strands of the midrib more in the form of a crescent than of a circle when viewed in transverse section.

Ancistrocladus wallichii Planch (M. Pierre 1730).

Hypodermal fibres occurring only above the vascular bundles as in *A. extensus*. Midrib. Xylem more irregular in outline than in the other species examined : vascular bundles in the peripheral ring of fibres very small.

Ancistrocladus uncinatus Hutch. et Dalz. (P. A. Talbot 3108).

Hypodermal fibres forming a network above the vascular bundles, as in *A. extensus* but locally extending away from the veins into the mesophyll. Mesophyll including several layers of palisade cells. Spongy mesophyll composed of smaller cells than in the previous species.

2. Stem of *A. barteri*.

Primary **cortex** composed mainly of thin-walled, parenchymatous ground-tissue with numerous sclereids embedded in it. Many of the sclereids sufficiently elongated to resemble fibres, and provided with thick pitted walls and wide or narrow lumina ; arranged in a broad, but very loose and interrupted, ring in the outer part of the cortex. A second loose ring of rather wider fibres noted in the ' pericyclic ' region, together with a few scattered fibres in the phloem. Boundary between the cortex and 'pericyclic' region not clearly defined in the material examined, but a single layer of crushed cells, with walls that tended to be stained yellow with chlor-zinc-iodide, observed at the inner boundary of the cortex may represent an endodermis. Structure of the phloem not well preserved in the material available. **Xylem** constituting a large part of the stem ; in the form of a closed cylinder traversed by mostly uniseriate, and occasional biseriate, rays. Vessels almost exclusively solitary, but tending to be arranged in groups or multiples in the primary xylem, mostly 45 90μ in radial diameter, the widest vessels being in the youngest wood ; members 225–375μ long. Pits in the lateral walls of the vessels rather widely spaced, with oblique to vertical, and sometimes crossed, apertures. Vessel-ray pits similar but less numerous. Perforations simple, very oblique. Parenchyma mostly apothracheal, in short bands 3 or 4 cells wide. Fibres. Ground-tissue of the wood composed of very thick-walled fibres with small lumina, the latter varying from slit-shaped to circular in transverse sections. Fibres arranged in rather ill-defined radial rows. Numerous, large, conspicuously bordered pits with oblique to vertical, slit-shaped apertures, present in both the tangential and radial walls of the fibres. **Pith** fairly wide, somewhat heterogeneous; composed of (i) almost cubical cells with numerous pits in the moderately thick walls and (ii) cells of a similar type but axially elongated. Most of the pith cells of both types appearing circular or oval in transverse sections.

Points of difference from the above description noted in other species were as follows.

Ancistrocladus extensus Wall. Lace 595. Thorel 800.

Groups of thick-walled fibres with narrow lumina extend into the pith from the region of the protoxylem. Sclereids in the phloem exhibiting very pronounced, concentric zones of thickening. Vessels 30–90μ in radial diameter ; members 220–390μ long.

Comparison of Dioncophyllaceae with Ancistrocladaceae.

The most notable similarities between the Ancistrocladaceae and Dioncophyllaceae are in the leaf. Here it may be noted that *Ancistrocladus* is characterized by sunken peltate glands on all of the leaves, whilst, in the specialized leaves of *Triphyophyllum*, the stalked glands are accompanied by multicellular sessile glands. The shape of the glands in the two groups is, however, somewhat different. Furthermore, as multicellular glands occur widely throughout the Dicotyledons, no special taxonomic significance should be attached to this feature by itself. Turning now to the stomata it will be remembered that many of them are, in both families, surrounded by a more or less clearly defined rosette of specialized epidermal cells, so that the stomata may be classified as actinocytic. Actinocytic stomata are uncommon in the Dicotyledons as a whole, for which reason their occurrence in both *Ancistrocladus* and the Dioncophyllaceae is a matter of some interest. Here again it should, however, be noted that similarity of stomatal type is of diagnostic value rather than of taxonomic significance. This is because, although a particular type of stoma may be confined to a relatively small number of families, there is no evidence that the families in question are taxonomically related. It is highly probable that similar stomatal types have arisen more than once during the course of evolution. A feature that appears to be of possibly greater significance in establishing the relationship of the Ancistrocladaceae to the Dioncophyllaceae is the peculiar type of vascular structure that occurs in the midrib and petiole of the two families. In the Dioncophyllaceae there is a central vascular arc of xylem and phloem, and, in *Ancistrocladus*, a cylinder or a very deep arc of xylem and phloem according to the species. This resemblance, by itself, is of no particular taxonomic significance because variously shaped arcs of xylem and phloem are widely distributed throughout the Dicotyledons. It is remarkable, however, that, in both families, the central vascular tissue is encircled by a zone of fibres in which additional vascular strands are embedded. This structure is unusual amongst the Dicotyledons, and its occurrence in the Ancistrocladaceae and Dioncophyllaceae is therefore of great interest. On the other hand, the stem structure in the two families is by no means outstandingly similar. The peculiar differentiation of the cortex of the Dioncophyllaceae into fibrous and parenchymatous regions finds no counterpart in *Ancistrocladus*. It may, however, be noted that sclereids are common in the cortex of *Ancistrocladus*, and they sometimes tend to be arranged in a broad, but very loose and interrupted, ring in the outer part. The characteristic manner in which vascular bundles are embedded in the fibrous part of the cortex of the Dioncophyllaceae appears to connect that family with the Nepenthaceae rather than with the Ancistrocladaceae, in which no such structure has been observed. The long, sparsely pitted vessel members with simple perforations, and the wood fibres with conspicuously bordered pits are similar in both families. Anomalous secondary thickening is, however, unknown in *Ancistrocladus* although it occurs in the Dioncophyllaceae.

(iv) *Comparison of Dioncophyllaceae and Linaceae.*

Members of the Dioncophyllaceae have been compared with *Ochthocosmos*, *Ctenolophon* and *Ixonanthes*, all of which genera belong to the

Linaceae. No strong evidence of affinities between the Dioncophyllaceae and these genera was found, but it seems worth while to draw attention to the nature of the anatomical differences between them. All of the 3 genera from the Linaceae that were examined agree with each other, and with many other members of the same family, in having paracytic (rubiaceous) stomata. This character clearly distinguishes these genera from the Dioncophyllaceae in which paracytic stomata are unkown. The same genera of Linaceae agree with the Dioncophyllaceae in having the ground-tissue of the wood composed of fibres with conspicuously bordered pits. This character, as has already been pointed out, is generally interpreted as being primitive or unspecialized rather than as indicating taxonomic affinity. The unspecialized nature of the wood of *Ctenolophon* is further emphasized by the occurrence of scalariform perforation plates in the vessels, a feature that has not been observed in the Dioncophyllaceae. The vessel-ray pits in *Ochthocosmos* and *Ixonanthes* are very large, simple and variously orientated. The vascular structure of the petiole of *Ochthocosmos* is complex, and unlike that of the variously shaped, but always simple vascular arcs that were observed in *Ctenolophon* and *Ixonanthes*. All of these genera differ from the Dioncophyllaceae in not having any peripheral vascular strands embedded in a fibrous zone in the midrib or petiole. One of the most interesting features that was noted was in *Ochthocosmos roraimae*, where it was confirmed that thin-walled elements with spiral thickening, resembling tracheids or vessel members, occur scattered in the mesophyll. These elements are not unlike the spirally thickened cells that occur in the cortex and phloem of the stem of *Nepenthes*. It would, however, be unwise to attach undue taxonomic significance to this feature by itself. On the whole, the observations that have been made, suggest that the taxonomic affinities between the Dioncophyllaceae and the Linaceae are not very close.

(v) Comparison of the Dioncophyllaceae and *Kielmeyera* (Guttiferae).

An anatomical comparison between the Dioncophyllaceae and *Kielmeyera* provided no evidence in favour of there being any close affinities between the two groups. *Kielmeyera*, in common with all other Guttiferae, is provided with numerous secretory cavities in the unlignified tissues (Fig. II, D). It also possesses paracytic (rubiaceous) stomata (Fig. II, C) which are likewise very characteristic of the Guttiferae and unkown in the Dioncophyllaceae.

Discussion and Summary.

This investigation has shown that there are a number of peculiarities about the leaf and stem structure of the Dioncophyllaceae. The same combination of characters is not known to occur in any other genus or larger group, a fact that emphasizes the rather isolated taxonomic position of the Dioncophyllaceae. On the other hand, some of the characteristic features of the Dioncophyllaceae are represented in a number of genera belonging to several families. Thus the glandular hairs, provided with vascular elements in their stalks, that occur on certain specialized leaves of *Triphyophyllum* show a marked resemblance to the almost unique 'tentacles' of the Droseraceae. It should be noted, however, that stalked glands with vascular bundles in their stalks have also been

recorded in certain genera of the Turneraceae and Passifloraceae. As pointed out by Mr. Shaw, Sprague has already suggested that affinities between the Dioncophyllaceae and Passiflorales may exist. Returning to the relationship of the Dioncophyllaceae to the Droseraceae, it should be noted that there are multicellular, sessile glands in *Triphyophyllum*, where they occur amongst the stalked glands just described. The sessile glands at once recall those that are present amongst the ' tentacles ' of the Droseraceae, and also the multicellular sessile glands of the Nepenthaceae. Similarity in the structure of the glandular hairs is, however, about the only outstanding anatomical character that is common to the Droseraceae and *Triphyophyllum*, but this may, in part, be due to differences in the habit of the plants concerned.

The Dioncophyllaceae show a marked resemblance to the Nepenthaceae in the structure of their stems, although it must be admitted that these are accompanied by notable differences. Thus, *Nepenthes* differs from certain members of the Dioncophyllaceae in showing no anomalous secondary thickening, and in possessing peculiar spirally thickened elements, resembling tracheids or vessel members, in the primary cortex and phloem of the stem. On the other hand, in both families, the primary cortex is differentiated into an inner zone of large, thin-walled cells, and an outer fibrous zone in which numerous vascular strands are laid down. This similarity is very striking, but, in assessing its taxonomic significance, it should always be borne in mind that the peripheral strands have their xylem and phloem arranged the opposite way round in the 2 families. The petiole structure in the same 2 families is also somewhat alike. The Dioncophyllaceae also resemble the Ancistrocladaceae in the structure of their stomata and petioles. The peltate sunken glands of *Ancistrocladus* also somewhat recall the sessile multicellular glands on the reduced leaves of *Triphyophyllum*, but it would be quite unjustifiable to attach too much importance to this similarity.

The Dioncophyllaceae do not exhibit any marked resemblance to *Ochthocosmos*, *Ctenolophon* and *Ixonanthes*, 3 genera of Linaceae with which they were compared. The family also differs in certain important particulars from *Kielmeyera* and all other investigated genera of the Guttiferae.

On balance, the anatomical evidence indicates that there may well be affinities between the Dioncophyllaceae and the Nepenthaceae and between the Dioncophyllaceae and Droseraceae. It is difficult to decide from the anatomical structure alone whether the few similarities noted between the Dioncophyllaceae and Ancistrocladaceae are an expression of true relationship, or whether they represent parallel developments in the 2 families. The anatomical structure lends little evidence to support the possiblity of a relationship between the Dioncophyllaceae with the Linaceae, and still less of affinities with the Guttiferae.

Thanks are due to Mr. G. Atkinson for preparing the drawings shown in Fig. III.

A NOTE ON PSEUDOHERMAPHRODISM IN DAPHNIPHYLLUM MACROPODUM MIQ.

S. G. Harrison.

This evergreen shrub is a native of China, Japan and Korea. The oldest planting of the species at Kew consists of three specimens growing adjacent to one another in the beds near the Temperate House. They are worthy of notice for the interesting range of sexuality which they exhibit, in a species which is normally typically dioecious. One of the shrubs bears normal ♂ flowers ; the second bears ♀ flowers, some of which have up to 10 short staminodes although these are frequently absent. The third shrub bears flowers which at first appeared to be ♀ flowers with rather large staminodes. The ovary was smaller in diameter than the ovaries of comparable ♀ flowers on the adjacent specimen, but the sessile stigmas did not appear to differ from the receptive stigmas of the latter plant. But, whereas in the one the ovules developed into normal fruits, in the other they rapidly aborted and it was soon apparent that the anthers were going to mature. This they did, producing pollen which was apparently quite normal. At this stage the pseudohermaphrodite flower could only be distinguished from the ♂ by the presence of a small ' peg ', the remains of the aborted ovule, whereas a slight hollow or pit was noticeable in a comparable position on the disc of the ♂. There was a tendency in both of the staminate plants for the arrangement and thickness of the filaments to be somewhat irregular. At the

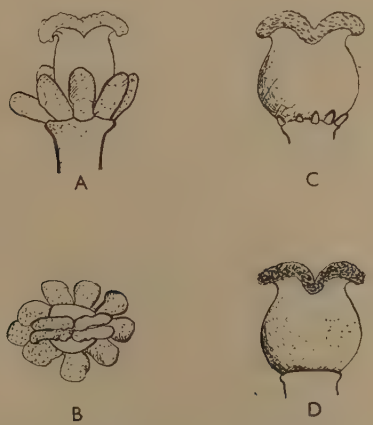

Fig. 1. × 6. Comparison of the normal ♀ with the ♀ stage of the pseudohermaphrodite.

A. Side view, and B. View from above, of the ♀ stage of the pseudohermaphrodite, showing apparently normal stigmas and immature stamens.

C. Ovary from the normal female plant, staminodes present.

D. Ovary from the normal female plant, staminodes absent.

end of August, 1951, the fruits on the ♀ plant were developing satisfactorily, whereas a careful search of the pseudohermaphrodite confirmed the assumption, made in early June, that all the ovules had aborted.

Fig. 2. × 6. Comparison of the normal ♂ with the ♂ stage of the pseudohermaphrodite.
A. Pseudohermaphrodite flower with anthers mature. The aborted ovary remains as a peg in the centre of the disc.
B. Normal ♂. Note the pit in the centre of the disc.

Observation in future years should determine whether this form of pseudohermaphrodism is constant or not.

I have to thank Mr. J. Souster, Assistant Curator, for drawing my attention to this plant.

'Limnophila' viscida Ridley.—This supposed Scrophulariaceous species was described from Perlis, in the northern part of the Malay Peninsula, in *Journ. Roy. As. Soc. Str. Br.* **59,** 142 (1911). Recent examination of the isotype (*Ridley* 15150) preserved in the Kew Herbarium has revealed that it is the rather widespread and variable Indian Acanth., **Staurogyne glauca** (*Nees*) *O. Kuntze*. This has apparently not previously been recorded from the Malay Peninsula, and its occurrence in Perlis probably represents the extreme south-easterly extension of its range. The nearest hitherto known station is Tenasserim, in Lower Burma. The Indian range of *S. glauca* extends from the N.W. Himalayas to Madras and Ceylon, eastwards to Burma, Siam and Indo-China ; cf. Benoist in *Bull. Soc. Bot. France*, **60,** 266–7 (1913).—It is a curious coincidence that this species had already once previously been described as a presumed Scrophulariacea, viz. *Herpestis cochinchinensis* Bonati in *Bull. Soc. Bot. Genève*, sér. 2, **5,** 100 (1913) : *vide* Benoist in Lecomte, *Fl. Gén. Indo-Chine*, **4,** 624 (1935).

H. K. Airy Shaw.

Uncaria grandifolia Baker.—The type of this alleged new species, described in *Bull. Misc. Inf.*, Kew, **1896,** 23 (1896), from material sent by Governor Creagh from North Borneo, consists of a fruiting branch of the common *Uncaria cordata* (Lour.) Merr. (*U. pedicellata* Roxb.) (Rubiaceae) and a leafy branch of *Horsfieldia grandis* Hook. fil. (Myristicaceae). The characteristic hispid-pustulate leaves of the latter are perfectly alternate in the specimen, but Baker does not comment on this, though he notes "stipulis caducis ". Moreover, the stem of the *Uncaria* is sharply tetragonal, and glabrous or minutely tomentellous, whereas that of the *Horsfieldia* is terete and densely ferrugineous-lanate. It is incredible that such a fantastic mixture could have been made the basis of a supposed new species.

H. K. Airy Shaw.

EDIBLE PINE KERNELS.

S. G. Harrison.

The seeds of all pines have a theoretically high food value, as they are rich in fats and proteins, but only about 18 species of the genus *Pinus* produce seeds which are large enough and of sufficiently attractive flavour to be considered edible. In some species which might otherwise be suitable, the terebinthine flavour is too pronounced to be palatable. Nevertheless, a sufficiently large quantity of pine kernels is eaten in various parts of the world for the genus *Pinus* to be worthy of consideration as a distinct contributor to the diet of mankind.

In Europe, the best known and most important edible-seeded pine is undoubtedly the Stone Pine, *Pinus pinea* L., the kernels of which are imported into Britain as ' pignolias ' or ' pignoli '. On the continent they are variously known as ' pignons ' and ' pomme de pin ' (Fr.), 'pinocchio' and ' pinoli ' (Ital.) and ' pinones ' (Sp.). The tree is a native of the Mediterranean region, where it is a familiar feature of the landscape, from Portugal to Asia Minor, but the extent of its natural range is confused by the antiquity of its cultivation. Italy and Spain are the chief commercial producers of pignolias. The kernels were eaten preserved in honey in Pliny's time, and have been found amongst domestic supplies in the ruins of Pompeii. Their presence in the refuse dumps of Roman camps in Britain indicates that they were probably a part of the rations of the Roman Legions. The variety *fragilis* Du Hamel differs from the type in having thin-shelled kernels and is presumably also very old if a description of a variety with tender shells given by Pliny can be accepted as being essentially the same as the modern variety.

In Italy the traditional uses of the kernels are in soups and ragoûts, and Loudon mentions them as an ingredient in " Maritozzi buns." To-day they are largely used for making sweets. Italian chocolate manufacturers mix them with cocoa to produce a sweetmeat which is considered to be a great delicacy. As dessert they are eaten in much the same manner as " peanuts ", either raw, roasted or salted, or with a little lemon juice. They may also be used in the manufacture of marzipan, nut butter, nut-powder and other vegetarian foods.

Pinus pinea is widely distributed in Italy, but commercial collection of the cones is confined to certain areas in Central Italy, principally in the Roman, Ravenna and Pisa districts, including the pine groves of Migliarino and Ravenna in the east and maritime Tuscany in the west. The pine-cone harvest is from October to the end of March. The cones are collected by means of a long pole with an iron hook at the end. They are heaped up in piles 20–30 metres long, and about 30 cm. high, being graded to some extent as they are stacked. Exposure to the atmosphere and the heat of the sun assists the expansion of the cone-scales, thus facilitating the separation of the seeds from the cone. Extraction of the seeds may be either manual or mechanical. The former method involves the beating of the cones to complete the loosening of the seeds, which are then passed through a sieve. The latter method is similar, but the extraction is done by a kind of mechanical thrasher. The seeds are then crushed mechanically, by cylinders, to extract the edible kernels from the hard shells, which are separated by sifting. A second sifting

serves to eliminate the skin surrounding the kernels and the latter are then sorted into (a) edible (large and small), (b) non-edible (discoloured and deteriorated). Only the best quality kernels are exported : those of lower quality being retained for home markets. In addition to their use as human food the best kernels also yield an oil for pharmaceutical purposes and the broken and non-edible residue are used almost exclusively as a source of oil for soap making. They may also be used for feeding animals. The shells and cone scales constitute an excellent fuel for furnaces. The testa from the kernels is used as a colouring matter for fishing nets : it is also used in tanning, as it contains from 19 to 25% of tannin. Production of kernels in Italy has increased considerably during the last few years, as the following figures indicate :—

Production of Pine-kernels in Italy, 1948 to 1950.

1947–8	1,115,000	kilogrammes
1948–9	2,247,000	,,
1949–50	3,243,000	,,

In Spain, the best pine-kernels are produced in the south, particularly in the Huelva district. Those grown in northern districts are considered to be inferior in quality.

Pignolias are imported into Britain packed in 120 lb. cases lined with greaseproof paper. They are generally called " Pine kernels " in the trade, and are sold by this name, packed fresh in cellophane packets. They are appreciated by epicures for their delicate flavour and high food value and are sometimes used for the decoration of cakes and trifles. The demand for them is quite small however, for the British public prefers harder, crisper kernels for dessert. The possibility of increasing the demand by promoting the sale of roasted kernels is being investigated commercially and should be worth while, judging by the popularity of other roasted nuts in this country, and of roasted pine-kernels wherever the demand has been stimulated.

The Arolla Pine, *Pinus cembra* L., yields edible seeds. These are eaten in Switzerland and occasionally in this country, but more extensively in Russia, where the species is known as " Cedar ". In Europe it is confined to Alpine regions, generally above 5,000 ft., as a native tree, but it occurs at much lower levels in Siberia. The seed is highly valued in Russia, where the harvest commences during August and is often carried out by primitive and destructive methods. The cones are pulled or knocked off the trees by climbers, or else the main branches or even whole trees are cut down. The seeds are either extracted naturally, by allowing the cones to dry so that the scales open, or mechanically, by means of rollers. They are then shelled, sifted and winnowed and are usually marketed in the following January. The seeds of the Dwarf Siberian Pine, *Pinus pumila* Regel, are also eaten in Russia, and those of the closely related Korean Pine, *Pinus koraiensis* Siebold & Zuccarini, are used for confectionery in Manchuria.

Gerard's Pine, *Pinus gerardiana* Wallich, has seeds up to 1″ in length which are an important article of food in the Himalayas, from Tibet to Afghanistan and northern Baluchistan. They are also imported into Pakistan and India. The Baluchi and Afghani tribesmen collect the

cones by means of long hooked poles and are sometimes so zealous in their work that concern has been expressed lest there be no cones left to produce seed for natural regeneration of the forests in future years. The cones are gathered when still green and are stacked in heaps which are fired so that the heat expands the cone scales and allows the seeds to be extracted.

The North American continent is richer in edible nut pines than is the Old World, but in the United States the native species have only recently competed successfully with the pignolias formerly imported in large quantities from Italy and Spain. *Pinus cembroides* Zucc., and its varieties *P. c.* var. *edulis* (Engelm.) Voss, *P. c.* var. *monophylla* (Torr. & Frém.) Voss, and *P. c.* var. *parryana* (Engelm.) Voss, are the most important commercially, especially *P. c.* var. *edulis*, which is the mainstay of the Pinon nut industry developed in New Mexico since the early 1930's, although the value of the nuts was known to the early Spanish explorers about 400 years ago. Pinons have long been collected and eaten, raw or roasted, by the Navajos, Hopis and other Indian tribes. They are also used in the form of meal as an ingredient of cakes, and the Navajos use a nut paste in a similar manner to butter. Any surplus nuts are bartered at trading posts and this was the only form of trade in this product prior to commercial production. The cones are still gathered by the natives, amongst whom the Navajos are said to be the most skilful pickers, and the annual crop is believed to be in the neighbourhood of 7 million lbs. in good years. It has been estimated that a square mile of good pinon timber will yield at least 10,000 lb. and that there are approximately 100,000 square miles of *Pinus cembroides* var. *edulis* in the southern U.S.A., so it is evident that, even allowing for possible exaggeration, there is still room for much expansion of the industry, especially if thinning and proper forest management can be practised.

Pinon nut crops tend to be irregular and local, but in such an extensive area there is a good crop somewhere nearly every year, and in exceptional years bumper crops may be widespread. The U.S. Forest Service has carried out research on management and assists dealers and pickers to locate commercial crops. It has issued instructions for recognizing the early stages in the development of cones and estimation of crops in advance. The growth rate of Pinon nut pines is slow, generally only 2″ to 6″ per year, and the height of mature trees is often only 15 to 25 ft., although they may reach 40 ft. under favourable conditions. A tree generally starts coning at about 25 years, but may not bear well until it is about 75 years old.

The " processing " of the nuts has been satisfactorily mechanised, with the development of a machine sheller said to be capable of producing 200 lbs. of ' meats ' per hour, with a breakage of not more than ½%, operated by unskilled labour. The shells are removed from the kernels by an air separator and the latter are then hand-sorted to remove rancid and discoloured kernels and the small percentage which have remained unshelled. The kernels are either dried for sale in the raw state or else roasted in oil, and are sold in New York and other eastern cities as " Indian " nuts. They are often manufactured into nut-toffee, brittle, caramels and other sweets or candies. They are said to be superior to

the kernels of *Pinus pinea* imported from Italy and Spain, in both flavour and usefulness.

The distribution of *Pinus cembroides* var. *edulis* extends from eastern New Mexico to central Arizona, and central Colorado to southern New Mexico, including south-eastern Utah. The nuts are considered to have a delicate flavour and roast to an attractive golden brown colour.

The single-leaved nut pine, *Pinus cembroides* var. *monophylla*, may produce a higher yield of nuts than the former variety, but the meat is said to be somewhat hard and possesses a terebinthine flavour. The variety is found from central Utah, through Nevada, to the California Mountains.

The typical Mexican nut pine, *Pinus cembroides*, of Old Mexico, yields small pink kernels which roast to a greyish colour.

The four-leaved nut pine, *Pinus cembroides* var. *parryana*, is found in Riverside and San Diego counties, California and in the peninsula of Lower California. The kernels are good, but the supply is limited.

Pinus cembroides and its varieties can be grown in the British Isles but their value here is purely arboricultural and they do not possess the picturesque habit of the Stone Pine.

There are a number of other North American Pines which yield edible seeds. The White-Bark Pine, *Pinus albicaulis* Engelmann, bears seeds up to $\frac{1}{2}''$ long which are used for food. It occurs at altitudes of 5,000 to 12,000 ft. in the Rockies, from N. Wyoming, Idaho, Mexico and S. California to British Columbia.

The Sugar Pine, *Pinus lambertiana* Douglas, has seeds about $\frac{1}{2}''$ in length which are eaten in California and Oregon, where the tree occurs between altitudes of 2,000 and 9,000 ft. The species has the disadvantage that it does not cone freely, even in its native country, and does not start coning at all until fairly mature.

The Western White Pine, *Pinus monticola* Douglas ex Lambert, has seeds about $\frac{1}{3}''$ in length, which are eaten in California, where the tree grows up to an altitude of 10,000 ft., often associated with *Pinus lambertiana*.

The Digger Pine, *Pinus sabiniana* Douglas, produces large seeds, about $\frac{3}{4}''$ long, which at one time formed an important article of food for the Indians of the Sierra Nevada and Coast Ranges of California.

The Big-Cone Pine, *Pinus coulteri* Don, has seeds about $\frac{1}{2}''$ long, small in proportion to the large size and weight of the cone, but large enough to be worth eating.

The Torrey Pine, *Pinus torreyana* Parry, produces large seeds, about $\frac{3}{4}''$ long, and the trees usually cone heavily, but as the species has a very limited range the food value of its seeds is not well known.

Jeffrey's Pine, *Pinus jeffreyi* A. Murray, and the Western Yellow Pine, *Pinus ponderosa* Douglas, produce edible seeds which are sometimes collected and used locally, but these two species cannot be considered of great importance. The latter, especially, has seeds only about $\frac{1}{4}''$ long which cannot be economically shelled for food.

It appears probable that mechanisation of pine-kernel production may become more widespread, so that increased production may be obtained

from existing stands of trees. Planting for nut production alone can rarely prove economical unless the timber can also be utilized, and unfortunately many of the nut-pines produce timber which is of little use except for firewood. The more important nut-pines at the present time, *Pinus pinea*, *P. cembra*, *P. cembroides* and *P. gerardiana*, produce timbers which can be used locally for various purposes and are probably the most valuable generally.

Selection, in which variation in nut size is the criterion, can be expected to develop improved strains, and it is possible that the good qualities of different species might be combined through hybridization. Improvement by the production of polyploids is also a possibility.

I wish to acknowledge my indebtedness to the Ambasciata d'Italia, Ufficio del Consigliere Commerciale, London, for information and data referring to *Pinus pinea* in Italy, also Mr. E. H. Ellis, of Mansfield, Notts, for information about commercial aspects of the importation of *P. pinea* kernels into this country.

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West African Birds*—We have received the last volume of this magnificent work. It contains a large series of additions to the accounts of the birds, their habits and distribution which have been received from his contributors since the publication of the first volume, and an extensive index of the scientific and English names of the birds of the whole series. It contains 15 beautiful drawings in black and white of the new species added to the list, among which are the Bittern, Pockard and Gadwall, all familiar British birds. Altogether, there are 21 records of additions to the bird fauna of which four are not previously described, and there are extensive and most valuablea ccounts of the habits and distribution of the species previously recorded.

The author intends to produce a condensed edition of this work in Hand-book size in three volumes copiously illustrated, so that it can be conveniently handled and will certainly be valued by travellers not only in West Africa but in many other parts where a large proportion of these birds will be or may be found.

H. N. Ridley.

*Birds of Tropical West Africa, vol. 8, by D. A. Bannerman. The Crown Agents for the Colonies.

Wild Flowers of Chalk and Limestone*—In this volume Mr. Lousley gives us a unique personal record of his own plant-hunting on the calcareous soils of Britain. While reading it one should remember that although the book is unique, the story that it tells is not. Mr. Lousley is one of a large company of botanists who have devoted much of their leisure time to the study of the distribution of plants within Britain. If his book is largely a personal story, it is, none the less, a memorial to the labours of all.

Mr. Lousley's book will bring much pleasure to his fellow botanists and they will glean many facts of interest from his pages. Nevertheless in reading it the nature of the record must always be kept in mind. The plan followed is virtually a tour of the chalk and limestone areas of the country beginning (after a more detailed introductory section on Box Hill, selected as a typical chalk area) from the chalk cliffs of Dover. After the North Downs, come the South Downs and then the Isle of Wight. Here we are told that the Bastard Toadflax, *Thesium humifusum*, is abundant on the Wight chalk. This is perfectly true ; but it is the first mention of the plant and the casual reader might think it necessary to go to the Isle of Wight to see it, although he may find it within 30 miles of London on the North Downs. Plants are necessarily mentioned, in a book of this type, where they are noteworthy or have personal associations for the author.

In his preface Mr. Lousley has attempted to forestall the criticism that he deals overmuch with rarities. He would have done well to omit this and leave the reader to accept the obvious fact that the plant hunter is most interested in uncommon species. For his defence that they " so often provide the most suitable examples of plant geography and illustrate differences between the habitats better than subtle variations in the proportions and behaviour of the common species " is surely untenable. Amongst the rare species the role played by chance in their distribution is inevitably greater than it is amongst common forms, and consequently the absence of a rarity from a given locality gives little scientific basis for the comparison of that locality with another when the rarity is present.

The illustrations are generally good, but are sadly marred by incorrect legends, for on two plates (nos. 5 and 22) the right hand plant is described as the left and the left as the right. Such glaring errors should surely have been spotted and met by the insertion of an *erratum* slip: both may well lead to confusion. Plates 16, 18 and 21 are spoilt in colour by the over-emphasis of the brown tones and the photograph of the henbane (plate 13) is an unhappy effort taken from such an angle that the plant towers over one like a 12 ft. hedge.

The schoolboy reader will cackle with delight at consistently finding the discordance *Cirsium acaulis* (the epithet should be in the Greek form, *acaulon*) and the botanist familiar with Latin names will wonder why *Euphorbia lathyrus* replaces the more familiar *E. lathyris* for the Caper Spurge. The fact is that Linnaeus wrote *lathyrus* in the first edition of Species Plantarum although he took the name from a synonym, *lathyris*. In the second edition he effected the change to *lathyris* and this has been generally, and rightly, adopted.

B. L. Burtt.

*Wild Flowers of Chalk and Limestone, by J. E. Lousley. Collins, 1950. Price 21/-.

THE IDENTITY OF OPHIORRHIZA LANCEOLATA FORSK.

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During the course of my work on the genus *Pentas*, it became necessary to examine the type of *Ophiorrhiza lanceolata* Forsk.[1] This was made possible through the great kindness of the Curator of the Universitetets Botaniske Museum, Copenhagen. Although the studies are by no means complete, a request for the publication of my conclusion concerning *O. lanceolata* has been made so that a new name needed for inclusion in Dr. F. W. Andrews's " Flowering Plants of the Anglo-Egyptian Sudan " can be validated.

Forskål's plant has been much misunderstood by people who have not taken the trouble to examine it, and the resultant confusion has been great. Vahl[2] made the combination *Manettia lanceolata* in 1790 and this is the only other name that appears on the actual sheet. The species was again moved to *Neurocarpaea* by Robert Brown[3] but that need not be explained at length since the generic name is invalid. Britten[4] however took up the name in the sense of *Pentas carnea* auctt. and was followed by Hiern[5] in his treatment of Welwitsch's plants.

An examination of the type of *O. lanceolata* shows that it is undoubtedly a *Pentas*. The name has widely been synonymized with *Pentas carnea* Benth. Both Hiern[6] and Hooker[7] took this view. The combination *Pentas lanceolata* was made first by Deflers,[8] who attributed it to Bentham & Hooker (where the combination was not actually made), and later by K. Schumann.[9] Deflers' combination has been much overlooked since it is omitted from the " Index Kewensis ". Schumann considered *Pentas lanceolata* to be synonymous with *Pentas carnea* though he actually had *P. Bussei* Krause (=*P. coccinea* Stapf) before him. Both Deflers[8] and Blatter[10] have treated *P. lanceolata* as a synonym of *P. carnea*. Stapf, who saw a specimen of Forskål's plant which is preserved in the British Museum Herbarium, rightly pointed out that the cultivated *P. carnea* Benth. is not the same as Forskål's plant.

Scott Elliot[12] in his " Revision of the Genus *Pentas* ", which is little more than a badly digested list, completely misunderstood K. Schumann's *P. lanceolata*. The exact relationships of Forskål's *Pentas* to other members of the genus must await the completion of my studies. Suffice it to say that it is closely related to *P. ainsworthii* Scott Elliot and to *P. schweinfurthii* Scott Elliot. The names are however so confused in their present applications that no further conclusions can be put down here.

We must now turn to the other interpretation which has been put on Forskål's plant. Delile[13] in 1826 transferred *Ophiorrhiza lanceolata* to *Mussaenda*, giving it a new epithet, *luteola*, presumably because he knew that there was already a *Mussaenda lanceolata* Poir.,[14] based on a different plant which was said to be a native of the Ile de France (Mauritius). Under the name *M. luteola*, Delile described and figured a plant which is very different from *Ophiorrhiza lanceolata*, and which is the familiar bright-yellow flowered plant, with one calyx-lobe foliaceous, which has for long been known by Delile's name. It is clear however that Delile's combination *M. luteola* is a nomenclatural synonym of Forskål's *O. lanceolata*, being based on the same type. Furthermore, the combination *M. luteola*

is illegitimate, since Delile cited *M. aegyptiaca* Poir. (a legitimate name also based on *O. lanceolata*) as a synonym.

De Candolle[15] placed *Ophiorrhiza lanceolata* Forsk. as a synonym of *Mussaenda luteola* Delile, but excluded the synonym *M. aegyptiaca* Poir. Bentham and Hooker however realized that Delile had identified his plant incorrectly.

Despite this, Wernham[16], when founding his new genus *Pseudomussaenda*, for Delile's yellow flowered plant made the combination *P. lanceolata* (Forsk.) Wernham. His new genus is probably justified, though its place in the *Condamineae* needs investigation, but the combination *P. lanceolata* cannot be used now that the identity of Forskål's plant is established. Delile's plant therefore requires a new name and diagnosis.

Pseudomussaenda flava *Verdcourt*, sp. nov.

Mussaenda luteola Del. Cent. Pl. Afr. 65 t. l. f. l. (1826) *nom. illegit.*, pro parte, quoad descr. et ic. excl. syn.

Vignaudia luteola Schweinf., Beitr. Fl. Aethiop. **1,** 282 (1867), *nom nud.*

Pseudomussaenda lanceolata Wernham in Journ. Bot. 54, 298 (1916), pro parte excl. syn. Forsk. & Vahl.

Frutex erectus ad 3 m. altus, ramulis pubescentibus. *Internodia* 0·5–7 cm. longa. *Stipulae* parvae, in fimbrias 2 filiformes ad 4·5 mm. longas solutae. *Folia* elliptica vel oblongo-elliptica, acuta vel breviter acuminata, basi cuneata, ubique ± molliter pubescentia ad 3·6–9·5 cm. longa, 1·3–2·9 cm. lata ; petioli ± 0·5 cm. longi ; nervi laterales utrinsecus 7–9, leviter subtus prominuli. *Flores* in cymas pauciforas laxas conferti. *Flores* flavi dimorphi, alii microstyli, alii macrostyli; stamina semper in tubo ampliato tota inclusa, antheris subsessilibus ± 3·5 mm. longis. *Calycis tubus* hirsutus, lobi 5–6, subaequales, filiformes, ± 6 mm. longi vel unus saepius in laminam petaloideam flavam stipitatam oblongam vel ovatam basi cordatam 1·5 longam 1 cm. latam usque 5 longam 4·2 cm. latam productus ; stipes usque 2·5 cm. longus. *Corollae tubus* pilosus, elongatus, 2·5–3 cm. longus, intra ostium versus dense flavo-villosus ; lobi 5, ovati, apice caudati, 8 mm. longi, 5 mm. lati. *Stylus* gracilis, ramis 2 linearibus vel ovalibus. *Ovarium* 2-loculare, ovulis numerosis. *Capsula* oblonga, sublignosa, 7 mm. longa, 5 mm. lata, loculicide 2-valvis.

Anglo-Egyptian Sudan. Equatoria Province, near Alvolo on Rohl, 20 Dec. 1869, *Schweinfurth* 2855 (K.) :—corolla lemon yellow, bract pale yellow. Equatoria Province, White Nile, Neamgara (?=Neangara), Dec. 1862, *Petherick s.n.* (K.). Equatoria Province, Lado, Yei River, *Sillitoe* 272 (K.) :—large yellow bushes up to 3 m. Equatoria Province, Nimule to Rejas, Kirrippi (?=Kirrilla), sparsely on edges of khops, 10 Nov. 1921, *Lankester s.n.* (K.) :—bracts pale yellow, flowers bright lemon-yellow. Equatoria Province. Rejas Hill, Bahr el Gebel, 10 July 1929, *Simpson* 7318 (K.) :—bracts yellow, flowers yellow. Upper Nile, Jan. 1877, *Freeman and Lucas* 1 (K.). Blue Nile Province, Fung Dist., Wisko Pass among rocks, 13 Dec. 1929, *Aylmer* 36 (K.) :—small shrub. Regu, 25 July 1920, *Shantz* 928 (K.) :—shrub with bright lemon bracts.

Uganda. Northern Province, Acholi District, Gani, amongst rocks and rocky ravines of Gani and Madi, Dec. 1862, *Speke* 669 (K.) :—pretty shrub, leaves next to flowers canary yellow. Northern Province, West Nile Dist., Arua, 1360 m. alt., March 1931, *Hopkins* 1978 (K.) :—shrub with yellow flowers and one enlarged yellow calyx lobe ; and Arua Hill, 1260 m. alt., Jan. 1938, *Hazel* 418 (K.) :—height 1·2–1·8 m., flowers bright yellow with pale yellow bracts ; and Nebbi, in low tree savannah (of Okoro County), 930 m. alt., Sept. 1940, *Purseglove* 1053 (K., EA., ENT.) :—shrub 3 m. high, yellow bracts and flowers. Northern Province, Acholi Dist., Paimol, on grassy summit of small rounded granite hill, 18 July 1946, *Dawkins* 194 (EA.) :—thick densely branched shrub to 1·8 m. high, bark on older stems dark and pale grey in longitudinal streaks, flowers green at base of corolla tube becoming yellow distally, corolla lobes pale yellow, hairs of corolla tube orange yellow, one sepal frequently enlarged into a long-petioled pale yellow bract. Western Province, Toro District, Bwamba Co. Kabango, local in forest, 1230 m. alt., 29 Sept. 1932, *Thomas* 725 (Holotype, E.A., Isotypes, K., ENT.) :— spreading shrub, height 3·6 m., striking creamy white bracts, corolla bright lemon yellow with golden hairs at throat, stamens cream, stigmas green ; and Hakitenge (?=Hakitengya) in light forest, 17 Jan. 1932, *Hazel* 110 (K.) :—flower yellow ; and Bwamba at 700 m. alt., Oct. 1925, *Fyffe* 28 (K.) :—shrub. Western Province, Bunyoro Dist., Bungugu Co., Murchison Falls, 1942, *Bush* 121 (EA.) :—shrub with yellow flowers and pale yellow bracts ; and Sept. 1948, *Bally* 6377 (Coll. Harding) (K., EA.) :—shrub, not a climber ; and Nov. 1950, *Jex-Blake* (CM.) 10,063 (EA.). Mbola country at 1225 m. alt., 31 Oct. 1905, *Dawe* 630 (K.). Entebbe and on Hoima roadside, 1909, *Fyffe* 130 (K.). Lake Albert Scarp, March 1939, *Lindeman* 515 (K., EA.).

Kenya. Turkana Province, Zingout at 660 m. alt., May 1933, *Champion* T. 180 (K.) :—woody shrub with yellow flowers.

Tropical Africa. Lake Rudolf, very probably S.E. side, precise locality unknown, 2 Sept. 1899, *Wellby* s.n. (K.).

This species seems to be quite widely distributed in the upper Nile Basin. In brachystylous forms the style is about three quarters the length of the corolla tube and in dolichostylous forms the stigmas are just exserted. The buds are apiculate and bear 5 filiform apical appendages, a fact of some phylogenetic value, and also exhibited by *Conostomium quadrangulare* (Rendle) Cuf. (Syn. *Pentas quadrangularis* Rendle). The ovules are born on the marginal portions of two curved longitudinally situated lamellae in each loculus. There is no apical dehiscence such as occurs in some *Hedyotidae*. A comparative study of the placentation will probably settle the true position of this plant.

I wish to thank Mr. J. E. Dandy and Mr. E. Milne-Redhead for checking my references and for advice on the correct application of the International Rules of Nomenclature, and Mr. J. Lewis for completing the list of specimens cited.

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The Origins of Cultivated Plants*—There are doubtless many who will like to have an account of the researches of Nikolai Ivanovich Vavilov on the origin of cultivated plants which he carried out over a period of many years. Whether we accept as final or not all the conclusions reached by him, in no way detracts from the interest that "these classics of botanical–agricultural literature will arouse". By translating this volume of selected writings from the original Russian, Dr. Chester and his helpers have rendered into English valuable contributions to our knowledge, thus making them available to a wider field of interested workers.

The volume opens with an introductory essay on "Plant Breeding as a Science", followed by others on the "Phytogeographic Basis of Plant Breeding", "The Law of Homologous Series in the Inheritance of Variability", "Study of Immunity of Plants from Infectious Diseases", "Scientific Bases of Wheat Breeding", and a "Selected Bibliography of the Basic World Literature on Breeding and Genetics of Wheat". An author index and an index of plant names are provided.

Dr. Chester is to be congratulated on this excellent piece of work which will serve as a tribute to one of the great figures in the realms of botanical and agricultural science. The work is nicely printed and maintains the high standard set by the publishers.

H. S. Marshall.

*The Origin, Variation, Immunity and Breeding of Cultivated Plants. Selected Writings of N. I. Vavilov. Translated from the Russian by K. Starr Chester (Chronica Botanica, vol. 13, nos. 1–6). Waltham, Mass., U.S.A.: Chronica Botanica Co. 1951. Pp. xviii + 364. Price $7.50.

TWO NEW SPECIES OF PENTANISIA HARVEY FROM KENYA COLONY TOGETHER WITH A KEY TO DISTINGUISH THE SPECIES WHICH OCCUR IN THE COLONY.

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Amongst the material of *Pentas zanzibarica* (Klotzsch) Vatke in the Herbarium of the Coryndon Museum several specimens of an unknown *Pentanisia* were discovered. Mr. E. Milne-Redhead very kindly searched in the Kew Herbarium and found additional material. At my request Mr. R. W. Rayner looked for the species and was successful in discovering excellent living material and I am indebted to him for presenting me with a large quantity of the plant. This will enable duplicates of the type to be distributed.

Pentanisia foetida *Verdcourt*, sp. nov. affinis *P. prunelloidi* (Kl. ex Eckl. & Zeyher) Walp. (var. *latifolia* (Hochst.) Walp.) foliis breviter sed distincte petiolatis, majoribus, floribus minoribus differt.

Herba perennis basi ramosa, caulibus pluribus semi-prostratis apice erectis usque 60 cm. longis. *Internodia* supera hirsuta 0·5–3 cm. longa, infera usque 10 cm. longa. *Stipulae* in fimbrias ± 5–7 subaequales filiformes usque 3·5 mm. longas solutae. *Folia* ovata vel ovato-lanceolata breviter petiolata (petiolis usque 4–7 mm. longis), lamina 5–7 cm. longa et 1·8–2·5 cm. lata acuta basi late cuneata vel ± rotundata, utrinque breviter pilosa. *Nervi* laterales utrinque 8–9. *Flores* dimorphi, lilacini, in capitula terminalia vel axillaria spiraliter condensati interdum capsulis serius in spicas usque 5 cm. longas confertis. *Pedunculi* usque 3·5–4 cm. longi ; pedicelli 0·3 mm. longi. *Calycis* tubus ovoideus ± glaber, 1–1·5 mm. longus et 0·75–1 mm. latus ; calycis lobi ± 5, unus foliaceus ciliatus 4–5 mm. longus et 1–2 mm. latus, ceteri minutissimi c. 0·5 mm. longi hirsuti. *Corollae tubus* 5–9·5 mm. longus basi ± 1 mm. latus apice 1·5–2 mm. latus extra appresse pilosus, intus supra staminum insertionem hirsutus. *Corollae lobi* 5–6, oblongo-lanceolati 2·5–3 mm. longi et 1 mm. lati, apice leviter inflexi, intus glabri extra ± pilosi. *Stylus* exsertus (flos macrostylus) 7–8 mm. longus. *Stigma* bifidum, lobis filiformibus papillosis 1·5 mm. longis. *Ovula* solitaria pendula. *Capsula* ovoidea brunneo-nigra, dicocca 2·5–3·5 mm. lata, 2·5 mm. longa ad apicem leviter attenuata.

Kenya. Limuru, Tigoni Dam, 2260 m. alt., 4th March, 1951, Rayner 421 (Holotype EA., Isotype BM., BR., FI., LISC., K., P., U.):— a perennial herb 0·6–0·9 m. high, straggling through margin of a stand of *Oenanthe palustris*, low bushes and grass on shore of dam ; stem greenish yellow tinged on the surface towards the light livid vinaceous to pale brownish vinaceous ; petioles, midribs and veins (upper and lower surfaces) greenish pallid ; leaves between darkish green and herbaceous green above, pale slightly yellowish-green underneath ; tomentum on lower surface of leaves and on stem pallid ; inflorescence rhachis greenish-yellow ; calyx deep yellowish-green ; corolla between purple and violet outside, between lavender and lilac inside ; hairs in throat the same, but much paler, anthers pale amber ; pollen luteous ; filaments pallid ; stigma and style branches between deep purple and violet ; style below junction pallid, slightly greenish near base ; ovary deep

yellowish-green ; no scent, but smells of carbon disulphide when bruised, especially the flowers and fruit. Limuru, by roadside amongst bracken etc., 2100 m. alt., 24th September 1934, *Napier* 3545 (C.M. 6716) (K., EA.) :—suberect herb with small pinky-mauve flowers ; leaves or whole plant have rather an unpleasant odour. Limuru, in grassland, 16th March 1933, *Mainwaring* in *C.M.* 5121 (K.) :—usually decumbent, flowers pale blue. Limuru, in grassland, 2100 m. alt., 13th July 1930, *van Someren* 270 : herb with purple flowers. Limuru, alt. 2100 m., November 1929, *J. McDonald s.n.* (K.) :—*Gasuria* (Kikuyu) ; suspected of tainting milk. Aberdares, 2100 m., alt. November 1922, *Mainwaring s.n.* (K) :—flowers white. Mt. Aberdare, at lower edge of montane forest, 12th March 1922, *R. & Th. Fries* 2197 (K.) :—flowers reddish-violet. Eastern side of Mt. Kenya, by river Kaseri, 22nd September 1922, *R. & Th. Fries* 1820 (K., S.) South Mt. Kenya, 2100 m. alt., October 1932, *Dale K.* 3050 (EA. & K.) :—somewhat scrambling herb to 0·6 m. in low scrub, flowers pink red. Crushed leaves emit smell of CS_2 Nyeri, in damp places, 18th December 1921, *R. & Th. Fries* 92 (UPS.).

In the living plant of *Pentanisia foetida* the base is somewhat woody and up to 6 cm. diameter, brown with obscure pale lenticels and with transverse crack-like marks in parts, glabrous and much branched. The branches are brownish near the base, but pale green and somewhat fleshy above up to 2·5 mm. in diameter save at the nodes which are peculiarly thickened, and up to 4·5 mm. in diameter. Rooting at the nodes was observed in one shoot. The branches are tinged purplish in places, somewhat shiny and glabrous below, and hairy with patent white multicellular hairs above. The stipules are yellow-green and there is usually one sessile colleter on either side of the 7 true segments which are themselves tipped with colourless colleters. As in other species of *Pentanisia* the stipule bases often dry a pale chestnut colour. As in all Pentanisias the lowest leaves are smallest. The leaves tend to be crowded at the apex of the stem, and are somewhat shiny above and not very hairy with short semi-adpressed hairs, but the hairs on the under surface are patent and longer. The flowers are lilac or pinkish-mauve, with a paler tube. In bud the tube is greenish and the limb is brighter pinkish-mauve. The entire corolla bears externally, white and magenta more or less adpressed hairs. The throat hairs are pale and inwardly directed. The inflorescence is usually trifurcate, each branch with a head of flowers about 1 cm. broad. The flowers are paired and the pairs arranged in close spiral ranks, the spiral usually consisting of three whorls. During fruiting the heads usually elongate until the fruits are distantly spaced on quite long spikes. Axillary inflorescences occur. The fruits are blackish, broadly ovoid, laterally compressed, and very slightly and very obtusely 6–7 lobed, narrowed apically, widest in the lowest third, rugose and wrinkled but not ribbed. They eventually separate into two cocci with woody walls. Raphides are numerous between the cocci and also occur in the corolla, calyx and leaves. Most parts of the plant smell quite strongly of carbon disulphide when crushed or extracted with alcohol. This presents an attractive problem to the plant physiologist. It is of course highly unlikely that the odoriferous compound is carbon disulphide but is almost certainly a complicated organic substance. This smell is also recorded for members of the New Zealand genus *Coprosma*.

This species is strikingly similar in a superficial way to *Pentas zanzibarica* but its real affinities are very clear. They lie with the South African *Pentanisia prunelloïdes* which is one of the most variable complexes in existence. The two celled ovary with rather horny wall is very similar in both species. The Kenya species is an outlier of a group which undoubtedly originated and evolved in Natal and the Transvaal. *P. foetida* is quite distinct from both the small oblong-leaved and the linear-leaved forms of *P. prunelloïdes* but it is quite similar to many of the broad-leaved forms particularly when they are also prostrate. The leaves are however undoubtedly different, in addition to the corolla tube being smaller. Moreover the peculiar smell has not been noted by the collectors of any of the two hundred sheets of the *P. prunelloïdes* complex which I have examined.

Another very distinct species of *Pentanisia* which has up to now never received a description, although it was given a name by the late Dr. O. Staff early in this century, is now described.

Pentanisia parviflora *Stapf ex Verdcourt*, sp. nov. ab omnibus speciebus adhuc descriptis, floribus minoribus circa 4·5 mm. longis facile distinguenda. Bullock in Bull. Misc. Inform. Kew **1933,** 80 (1933), *nomen nudum.*

Herba erecta annua. *Caules* 10–36 cm. longi, basi 1·5 mm. lati, ramosi, hirsuti. *Internodia* 4–11 cm. longa. *Stipulae* parvae fimbriatae, 3 mm. longae. *Folia* breviter petiolata ; petioli usque 3 mm. longi ; lamina leviter acuta basi cuneata, pilis parvis induta, anguste elliptica, 3–4 cm. longa, 0·6–0·8 cm. lata, vel lanceolata, 1·3 cm. longa, 0·2 cm. lata, vel ovato-elliptica, 1·7 cm. longa, 0·6 cm. lata. *Nervi* laterales utrinsecus 4 difficile distinguendi. *Flores* dimorphi in capitula ± pauciflora condensata c. 4 mm. lata conferti, calycis tubus c. 1 mm. longus pilis squamiformibus parvis indutus. *Calycis* lobi 3–4, lobus foliaceus unus vel nullus, 0·8 mm. longus, 0·5 mm. latus, ceteri minutissimi apice hirsuti. *Flos microstylus* :—corollae tubus leviter infundibuliformis c. 3 mm. longus extra glabrescens intus hirsutus ; corollae lobi 3 4 oblongi 1·5 mm. longi 0·9 mm. lati extra pilis parvis induti. *Flos macrostylus* :—corollae tubus in triente supero modice ampliatus c. 3 mm. longus, basi 0·4 mm. latus, apice 1·5 mm. latus extra ± glaber intus supra staminum insertionem hirsutus. *Corollae* lobi ± 1·5 mm. longi. *Stamina* in tubo ampliato tota inclusa antheris subsessilibus 1 mm. longis. *Stylus* exsertus tomentosus c. 3·3 mm. longus. *Stigma* bifidum lobis filiformibus papillosis 0·6 mm. longis. *Ovula* pendula. *Capsula* ovoidea 1·75 mm. longa, 1·25 mm. lata, apice leviter acuta, pilis parvis squamiformibus dense induta.

Uganda. Mengo Dist., Kipayo, in low grassy swampland, 1200 m. alt., Dec. 1913, *Dummer* 557 (K.) :—flowers, white. Teso Dist., Serere, in short grass and stony parts, 1150 m. alt., July 1926, *Maitland* 1295 (K.) and 1310 (K.) Mengo Dist., Junja Road, Kiagwe, in short grass, 1200 m. alt., Aug. 1931, *Snowden* 2188 (K.) :—flowers white, 15–30 cm. high. Teso Dist., Serere, following cultivation, 1100 m. alt., Nov.-Dec. 1931, *Chandler* 61 (K.) :—flowers white, having a pale blue tinge when ageing, height 30–37·5 cm. ; and May 1932, *Chandler* 672 (Holotype EA., Isotype K.) :—flowers white turning pale blue at a later stage height up to 37·5 cm. ; and July 1931, *Chandler* 794 (EA., K.) :—flowers white, height up to about 22·5 cm.

KENYA. Trans Nzoia Dist., Mt. Elgon, 1950—2300 m. alt., Oct.–Nov. 1930, *Lugard* 17 (EA., K.) :—erect to 20 cm. ; and *Lugard* 99 (EA., K.) erect to 20 cm. flowers blue. Trans Nzoia Dist. Mt. Elgon, on wet rocks, 2130 m. alt., Oct. 1931, *Jack* 21 *and* 76 (K.) and (?=) *Jack* (*C.M.*) 3573 (EA.) :—sprawling herb with tiny white flowers. Trans-Kipkarren, near Reserve, in farm garden, Oct. 1931, *Broadhurst-Hill* 446 (EA., K.) :—weed, flowers with 4 petals, starry, very pretty, bushy growth ; and, in long grass in same garden. *Broadhurst-Hill* 531 (EA., K.) :—flower pale pink. Trans Nzioa Dist., Kitale, caves of Elgon, in short grass, Nov. 1942, *Tweedie* 59 (EA.) :—annual to 10 cm. flowers white, faintly tinged with bluish mauve. Trans Nzoia Dist., S. Elgon, by roadsides in short grass of bush country, 2030 m. alt., May 1940, *Tweedie* 515 (K.) :—annual to 10 cm., flowers white, tinged bluish-mauve, stems pink, flowers all through rains. N.E. Elgon, 2500m. alt., *Tweedie* 746, 790 and 806 (K.) :—white flowers with a bluish tinge. S.W. Elgon 2200m. alt., *Tweedie* 755 (K.)

TROPICAL EAST AFRICA. Without locality, 1898, *Whyte* s.n. (K.) (with drawings of dissections by Stapf).

This plant is a weak herb with a small rootstock. The stems are pale or darker purlish brown, with crisped patent white hairs. There are slender branchlets arising from most of the nodes. The stipules have about 7 deltoid segments 1·5 mm. long from a base which is pale with darker chestnut markings. The flowers are in tiny heads supported by the apical leaf pair and there are usually two axillary flowering branchlets which overtop the true terminal one. The fruit is tardily dehiscent and there are masses of raphides apically between the two cocci. In habit the plant shows resemblances to the Spermacoceae and the tetramery of the flowers suggests further relationships though the generic placing is not to be disputed. In fact the relationship between the various herbaceous Rubiaceae is perhaps much closer than the present accepted (or rather tolerated) classification of the Rubiaceae will admit. The species is so very distinct from all its congeners that it would seem at first sight to need a new genus. I have however studied some three hundred sheets of various members of the genus in preparation for a monograph and it is clear to me that although the tetramery and minuteness of the flowers warrant a separate subgenus the plant agrees well in other respects with the genus in which Stapf was going to describe it.

Altogether four species of *Pentanisia* are now known from Kenya and the following key will serve to distinguish these :—

1 An annual plant with minute flowers ; corolla tube ± 3 mm. long *Pentanisia parviflora* Stapf ex Verdcourt

1 Perennial plants with larger flowers ; corolla tube exceeding 5 mm. in length 2

2 Plant with long decumbent stems ; flowers fetid when crushed *P. foetida* Verdcourt

2 Plant with erect stems ; flowers not fetid when crushed . . 3

3 Rootstock thick and woody ; leaves oblong and glabrous in Kenya plants ; corolla tube with slight scale-like indumentum to glabrescent ; ovary 2-celled *P. schweinfurthii* Hiern

3 Rootstock not thick and woody ; leaves lanceolate and hairy ; corolla tube with dense stubby indumentum ; ovary 2–5-celled . . . . . *P. ouranogyne* S. Moore

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Theoretical Botany*—One cannot help wondering whether students of botany preparing for examinations should nowadays be envied or pitied. They have available a large number of mostly excellent general and special compilations conveniently termed textbooks. These can be used to supplement, if not to replace, lectures delivered orally by a teacher. A good textbook is no doubt better than a bad lecturer but even the best book cannot stimulate thought, imagination, and enthusiasm for a subject so successfully as a good teacher in the flesh. While the modern student is aided by more and better books, he may feel overwhelmed by their increasing size and range and wonder if he can ever absorb their contents. There is also a danger in too much spoon-feeding. Facts are selected, pre-digested, and dished up so that the student has little chance of collecting his own data, of meeting and working out problems for himself, or of practical hypothesis and theory building. Many textbooks do not even encourage the student to become acquainted with original publications. Students at the university level should not be too dependent on textbooks.

The book* now under consideration is the first volume of a series of four. Assuming that the format, size, and price of the three volumes still to be published are the same as those of volume one, the complete textbook will occupy 10½ inches of shelf length, be composed of 4,276 pages, and will cost £14. Possibly students' incomes are much greater than they were in the days of more modest textbooks ! A distinctive, and on the whole valuable, feature is the large number of figures, reproduced in black and white from photographs, drawings, and diagrams. Unfortunately no references are given to original publications, except for a few in the text of the chapter in which the history of plant classification is outlined. Some of the drawings and photographs could easily have been reduced in size and the space used for a selection of references to modern researches.

It is stated that the present work aims to fill the gap between detailed treatises by specialists and elementary surveys. Whether this end is gained or not can only be fully and fairly judged when the four volumes are available for survey. The first volume suggests that there will be a considerable measure of success. It contains a brief introduction, an outline of cytology and another on the basis of classification, and eleven chapters covering the structure and life-histories of the cryptogams and gymnosperms, with introductions to plant histology and to the evolutionary morphology of the Spermatophytes interpolated. The last four chapters deal with the Angiosperms. There is a very brief, and rather inadequate, introductory chapter and excellent accounts of roots, stems, and leaves.

While this textbook is unlikely to be purchased by a majority of college students or even by most individual teachers, departments of botany teaching botany above an intermediate stage can hardly afford to be

*Textbook of Theoretical Botany 1, by R. C. McLean and W. R. Ivimey-Cook. pp. 1069, figs. 1041, Longmans, Green, and Co., 1951, 70/-.

without it. A companion volume with the title " Textbook of Practical Botany " is, it is stated, soon to appear from the same publishers. It has been compiled by the present authors as a practical laboratory guide for students.

W. B. TURRILL.

" **Capability Brown**."*—Under this title a book has now appeared which is of special interest on account of its bearing on the early history of Kew. Lancelot Brown or " Capability Brown," as he was curiously nicknamed, was probably the most celebrated landscape artist of the eighteenth century and was closely associated with the early development of Kew. He is reputed to have been responsible for the Rhododendron Dell, the Lake and much of the lay-out of the Gardens near the Thames.

George III's interest in Kew and in gardening, and his liking for a simple country life, are well known. Brown's work at Kew quite naturally brought him in close personal contact with the King and a happy relationship appears to have existed between them. It was also the means of bringing Brown into close contact with many of the influential people of that time, including Lord Bruce, then Lord of the Bedchamber. Brown was later commissioned to lay out the grounds of Lord Bruce's estate at Tottenham Park in Wiltshire on the fringe of Savernake Forest.

A royal appointment held by Brown was " Surveyor to His Majesty's Gardens and Waters at Hampton Court." It is said that George III invited Brown to demolish the magnificent formal lay-out on the east side which Brown tactfully refused to do " out of respect to himself and his profession." Brown is credited with having been responsible for the Great Vine at Hampton Court which still produces good crops of fruit.

The many well known English country mansions whose grounds still owe their charm to the original lay-out and the genius of Brown are dealt with in detail by the writer and are well illustrated with a number of excellent photographs. It is to Brown's genius that we largely owe our present conception of " natural " landscape design, for it was he who successfully revolted against the geometrical rigidity and formality of the Continental style of gardening that had held sway for so long in England, reaching its zenith probably in the reign of William and Mary. The landscape architecture that was later to be developed in other countries, notably in the United States during the nineteenth century, is freely admitted to be modelled largely on that developed by Brown in England during the eighteenth century.

The authoress gives an interesting account of Brown's early life, his humble origin and his rise to fame. Many facts, hitherto unrecorded, have been brought to light regarding his life and his remarkable and at the same time likeable personality.

It is fitting that this book, so well produced and written in a pleasing, easy style, should appear at the present time, for there is now a healthy appreciation of the problems of country planning, with a growing concern for the preservation of natural scenery and amenities including the general relationship of new buildings and highways to their surrondings.

H. S. MARSHALL.

*By A. Dorothy Stroud. Country Life Ltd. 1951. Pp. 224. £2.2.0 net.

SOME TROPICAL AMERICAN AGARICACEAE REFERRED BY BERKELEY AND MONTAGNE TO MARASMIUS, COLLYBIA OR HELIOMYCES.

R. W. G. Dennis.

In a previous paper* the writer has offered observations on the type collections of some tropical American Marasmii described by Berkeley, in which the pileus surface is covered by a layer of cystides-en-brosse. There remains a large number of species which lack this convenient anatomical character. Descriptions of recent collections referred to several of these viz. *Marasmius albofuscus* Berk. & Curt., *M. brasiliensis* Berk. & Mont., *M. cohortalis* Berk., *M. coracicolor* Berk. & Curt., *M. cubensis* Berk. & Curt., *M. dealbatus* Berk. & Curt., *M. fibrosipes* Berk. & Curt., *M. hirtellus* Berk. & Broome, *M. niveus* Mont., *M. omphalodes* Berk., *M. plectophyllus* Mont., *M. polygrammus* Mont., *M. purpureus* Berk. & Curt., *M. rhyssophyllus* Mont., *M. sabali* Berk., *M. semi-ustus* Berk. & Curt., *M. sericipes* Berk. & Curt., *M. subcoracinus* Berk. & Curt., *Collybia hemileuca* (Berk. & Curt.) Sacc., *C. luteo-olivacea* (Berk. & Curt.) Sacc. and *C. rheicolor* (Berk.) Sacc. will be found in a paper on Marasmius and its allies in Trinidad (Trans. Brit. Myc. Soc. in press). There follow brief notes on the type collections of the remaining species referred by these authors to *Marasmius* and a few which they referred to *Collybia* and *Heliomyces*.

In dealing with fungi of this kind, which usually lack cystidia and are represented in herbaria by specimens on which the spores can seldom be identified with confidence, one is forced to rely on less distinctive characters such as texture and thickness of the pileus, spacing, insertion and interveining of the gills. Size of the basidia is also worth noting as is the tramal structure when it can be clearly recovered in such old, often poorly dried material. Unfortunately even when a badly preserved pileus has been soaked up in dilute KOH solution and sectioned with a freezing microtome the hyphae are often difficult to distinguish. Thus it may be hard to be sure if their walls are gelatinised or not or to what extent this may be an artefact due to past treatment or to the method of recovery. This uncertainty arises especially in connection with certain species placed in category 6 below. To facilitate comparison between the species an outline sketch of part of a tangential section of the pileus at a uniform magnification of approximately 25 has usually been included in the illustrations. Because damage to types must be kept at a minimum the sections were taken within a few millimetres of the pileus margin and thus include the secondary gills if any occur.

The fungi are dealt with below in alphabetical order of their specific epithets. They can be sorted tentatively into a number of morphological categories, some well defined, others somewhat arbitrarily distinguished, viz :—

(1) Species with thick-walled pseudo-amyloid hairs, referable to *Crinipellis* : *Marasmius sarmentosus* Berk., *Collybia urbica* Mont.

(2) Species probably referable to *Mycena* :

(a) with gelatinous cuticle and large pleurocystidia : *Heliomyces decolorans* Berk. & Curt.

* Kew Bulletin *1951* pp. *153-163.*

(b) with dry, brush-like cuticular hyphae and no cystidia ; *M. petiolorum* Berk. & Curt.

(3) Species with a prominent rhizomorph : *M. tomentellus* Berk. & Curt., *M. brevipes* Berk. & Rav.

(4) Small or minute species with lateral or excentric stipes :

(a) with thickwalled tramal hyphae perhaps referable to *Panus* : *M. aleurites* Berk. & Cooke.

(b) with thinwalled hyphae, referable to *Pleurotus* in the wide sense :

(α) with hyphal cuticle : *M. obliquus* Berk. & Curt.

(β) with cellular cuticle : *M. concolor* Berk. & Curt., *M. haematodes* Berk. & Curt., *M. spaniophyllus* Berk.

(5) with hymeniform cuticle and apparent lactifers in the trama: *Collybia nigrita.*

(6) with pileus flesh not exceeding 90μ in thickness, formed of very slender hyphae, their walls strongly coherent and probably somewhat gelatinised, basidia usually very small : *M. caatingensis* Berk., *M. dilatatus* Berk., *M. pulchellus* Berk., *M. semisparsus* Berk. and perhaps *M. rugatus* Mont. *Marasmius subglobosus* Berk. & Curt. and *M. traganus* Berk. & Cooke are equally thinfleshed but have clearly gelatinised tramas like the species of category 8. *M. obscurus* Berk. is thinfleshed because of its minute stature but belongs structurally to category 9. So probably does *M. gamophyllus* Mont. which is in any case distinguished by its two-layered trama.

(7) with thin flesh like (6) but with lactifers and gloeocystidia (*Lacticollybia* Singer) : *M. holophaeus* Mont.

(8) thicker fleshed species with clearly gelatinised trama, referable to *Micromphale* : *Collybia boryana* (Berk. & Mont.) Sacc., *M. decurrens* Mont., *C. ixodes* Mont., *M. viticola* Berk. & Curt.

(9) with definitely non-gelatinised tramal hyphae of moderate width, referable to *Collybia* : *M. atroviridis* Berk. & Curt., *M. badius* Berk. & Curt., *M. bermudensis* Berk. *M. cinctus* Berk., *M. coilobasis* Berk., *M. cyathiformis* Berk. & Curt., *A. detersibilis* Berk. & Curt., *M. inoderma* Berk., *M. longipes* Mont., *M. obscurus* Berk., *M. tenerrimus Berk.* and *M. tortipes* Berk. & Curt.

The type collections of *M. coraciceps* Berk. & Curt., *M. tenebrarum* Berk. & Curt., and *Heliomyces sprucei* Berk. have the tramal structure too obscured to beplaced with confidence.

Marasmius aleurites *Berk. & Cooke* in J. Linn. Soc. Bot. **15,** 371 (1876).

Sporophores gregarious on dead sticks. Pileus white, 3·5 mm. diameter, slightly convex, smooth, pellucidly striate when soaked up ; gills rather crowded, of about four lengths, adnate, narrow ; stipe lateral, very short, smooth. Cuticular hyphae about 3μ wide, thinwalled, staining deeply in cotton blue, some apparently finely encrusted ; tramal hyphae

loosely woven, 3 4μ wide with thick hyaline walls and slender lumen stained in cotton blue, these hyphae protrude to form the sterile gill edge, no pleurocystidia, spores not recovered. Amorphous masses, perhaps of Calcium oxalate, occur in the hymenium and the surface of the stipe is powdered with large colourless tabular crystals. Fig. 1.

Type : Obydos, Brazil, 13.2.1874, *Trail.*

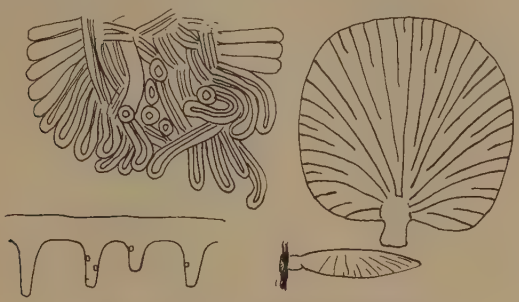

FIG. 1. *Marasmius aleurites.* Sporophore soaked up × 10, section of gill edge × 660.

Marasmius atroviridis *Berk. & Curt.* in J. Linn. Soc. Bot. **10,** 295 (1869).

Pileus convex, umbilicate with a minute central umbo, surface smooth, finely and indistinctly striate ; gills crowded, of two lengths, broad, adnate or perhaps slightly decurrent, yellowish brown when soaked up ; stipe smooth. Pileus cuticle of parallel hyphae, trama of thinwalled, closely woven hyphae, pleurocystidia absent, cheilocystidia short cylindrical hairs about 20–25 × 4μ, basidia about 12 × 4μ, spores not recovered. Fig. 2.

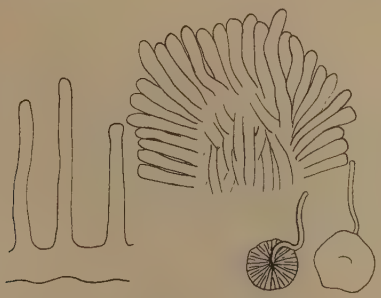

FIG. 2. *Marasmius atroviridis.* Dry sporophore × 1, section of gill edge × 660.

Type : Cuba, Wright 39. This collection at Kew contains four sporophores, all heavily impregnated with mercuric chloride so that they turn black in KOH solution. It may not be generally known that sections of such material transferred from KOH to water and thence to

Melzer's reagent are completely cleared and as easily examined as sections of unpoisoned sporophores.

Marasmius badius *Berk. & Curt.* in J. Linn. Soc. Bot. **10,** 294 (1869).

Pileus 1 cm. diameter, convex, dark purplish brown, soft and fleshy when soaked up, smooth ; gills rather broad, of two lengths, adnate, about 20 reach the stipe, slightly interveined, reddish brown ; stipe cylindrical, appearing downy under a lens and though most of this is mould there seem to be also some short hyaline cylindrical thinwalled hairs belonging to the agaric. Pileus surface and trama composed of thinwalled reddish brown hyphae about 4–5μ wide, no pleurocystidia and no distinct cheilocystidia but the gill edge is sterile, basidia about 20 × 4–5μ, probably four-spored, spores not recovered. Sporophores gregarious, not caespitose, amongst leafy liverworts on rotten wood. Fig. 3.

Type : Cuba, *Wright* 34.

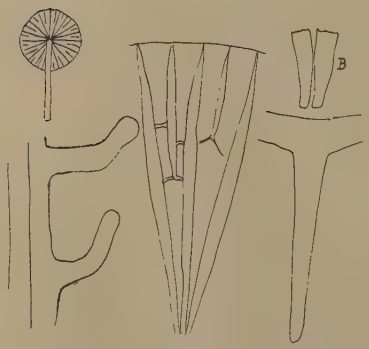

Fig. 3. *Marasmius badius.* Sporophore soaked up × 1, part of gill plan × 10, basidia and hairs of the stipe × 660.

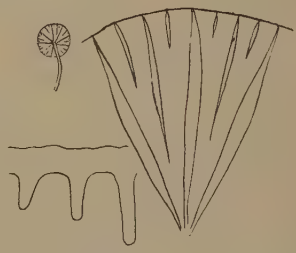

Fig. 4. *Marasmius bermudensis.* Sporophore soaked up × 1, part of gill plan × 10.

Marasmius bermudensis *Berk.* in J. Linn. Soc. Bot. **15,** 49 (1876).

Pileus about 5 mm. diameter, probably originally white, convex, smooth ; gills distant, narrow, of three lengths, adnexed ; stipe cylindrical, smooth, now yellowish-brown above, blackish below. Pileus surface hyphal, trama of loosely woven, non-amyloid, thinwalled hyphae, 2–3μ wide, gill edge sterile, of free hyphal ends, no pleurocystidia, basidia about 15 × 4μ, spores not recovered. This is probably an earlier name for *M. hondurensis* Murrill.

Type : on rotting wood, Poynter's Vale, Bermuda, Challenger expedition. Fig. 4.

Collybia boryana (*Berk. & Mont.*) *Sacc.*, Syll. Fung. **5,** 240 (1887).

Agaricus boryanus Berk. & Mont. in Ann. Sci. Nat. Bot. ser. 3, **11,** 235 (1849).

Pileus smooth, slightly convex, now clay coloured but probably originally white ; gills crowded, of two or more lengths, adnate ; stipe smooth, becoming somewhat excentric, now vinaceous russet at the apex

shading to almost black below. There is no specialised cuticle, trama homogeneous, of woven slender hyphae stained in cotton blue and embedded in a gelatinised matrix which remains glassy-white, gill edge sterile but there are no cheilo- or pleurocystidia, basidia about 10 × 3μ, spores not recovered. The sporophores have an odd superficial resemblance to those of *Lentinus detonsus* (see Kew Bull. **1950,** 330 (1951) but their structure seems to be that of a *Micromphale*. In this connection it is interesting that Montagne labelled the specimens he sent to Berkeley " an Heliomyces ", a genus often used by early mycologists for tropical agarics with translucent pilei and more or less gelatinised trama.

Type : on tree trunks, Bahia, Brazil. Leg. *Blanchet de Laurane*.

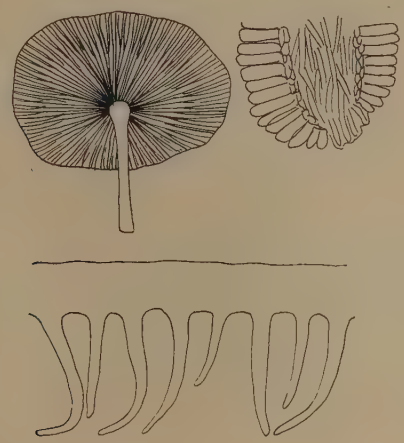

Fig. 5. *Collybia boryana*. Dry sporophore × 1, section of gill edge × 660.

Marasmius brevipes *Berk. & Rav.* in Ann. Mag. Nat. Hist. ser. 2, **12,** 426 (1853).

Sporophores scattered along slender, black, smooth rhizomorphs creeping over bark or directly erumpent from the bark. Pileus 6 mm. diameter, slightly convex, smooth, very dark reddish-brown ; gills distant, of two lengths, adnate, occasionally forked or interconnected, slightly paler than the pileus ; stipe short, cylindrical, smooth, black. Pileus surface of loosely woven hyphae about 3μ wide, encrusted with large reddish-brown granules not soluble in KOH solution, trama of more slender hyaline hyphae, non-gelatinised, not deeply stained in Melzer's reagent, no pleurocystidia, gill edge sterile, formed by firmly coherent dark brown hyphae 3μ wide, basidia about 17 × 3μ, probably four-spored, spores not recovered. Fig. 6.

Type : on dead *Quercus* twigs, Santee Canal, South Carolina, June, *Ravenel* 1527.

Marasmius caatingensis *Berk.* in Hooker's Journal of Botany **8,** 137 (1856).

Pileus 15 mm. diameter, flattened, smooth, whitish, translucently

FIG. 6. *Marasmius brevipes*. Sporophore soaked up × 3, habit sketch × 1, section of pileus pellicle and of gill edge × 660.

striate, flesh very thin ; gills subdistant, narrow, of three lengths, adnate ; stipe cylindrical, reddish-brown, apparently smooth, the scurfy granules mentioned by Berkeley seem to be extraneous amorphous matter. There is no specialised pellicle to the pileus, tramal hyphae 1·5–2μ wide, fairly closely woven, their walls probably somewhat gelatinised, gill edge sterile but no cheilo- or pleurocystidia, basidia 18 × 4μ, spores not recovered. Fig. 7.

Type : on the ground in forest, R. Uaupi, Brazil, March 1853, *Spruce* 86.

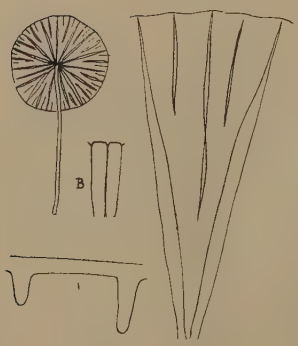

FIG. 7. *Marasmius caatingensis*. Sporophore soaked up × 1, part of gill plan × 10, basidia × 660.

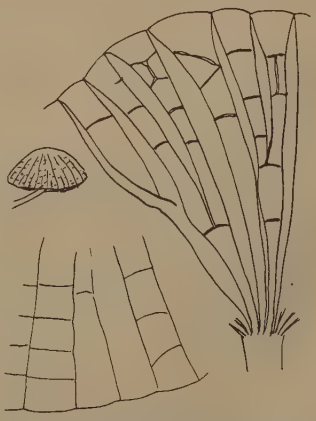

FIG. 8. *Marasmius coilobasis*. Small sporophore soaked up × 1, sketches of marginal portion of pileus and part of gill plan × 5.

Marasmius cinctus *Berk. apud Cooke* in Grevillea **16,** 121 (1888).

Pileus 10 cm. diameter, now flattened and very dark brown at the

centre, marginal 15 mm. much paler, surface smooth but finely radiately sulcate ; gills 5 mm. broad, subdistant, of two or more lengths, adnate ; stipe about 8 cm. × 4 mm., cylindrical, dark brown, fibrous, appearing shaggy in places. Pileus surface apparently formed of slender hyphae. There appear to be no cheilo- or pleurocystidia but the whole specimen is covered by moulds and the species is probably unrecognisable.

Type: a single sporophore on wood, Venezuela.

Marasmius coilobasis *Berk.* in Hooker's Journal of Botany, **8,** 141 (1856).

Pileus up to 1·5 cm. diameter, white, conico-campanulate, the surface closely striate-sulcate to the umbo and transversely, flesh very thin, soft and delicate, translucent when soaked up ; gills crowded, of two or three lengths, adnate, connected by transverse veins, thin white ; stipe cylindrical, smooth, white, hollow, arising from a small white patch of mycelium. The entire collection is very mouldy and neither cystidia nor spores are traceable, nevertheless I feel little doubt this is an earlier name for *M. cubensis* Berk. & Curt. Fig. 8.

Type : on rotten trunk, Panuré, Brazil, *Spruce* 1. The substrate is very soft and fibrous like a decaying palm trunk.

Marasmius concolor *Berk. & Curt.* in J. Linn. Soc. Bot. **10,** 299 (1869).

Pileus flattened, 2·5 mm. across, now chamois colour, smooth, translucent when soaked up ; gills distant, of two lengths, narrow ; stipe lateral, very short. Trama of slender woven hyaline hyphae, pileus surface formed of delicate pyriform cells about 5μ wide with thin smooth yellowish-brown walls ; gill edge fringed with hyaline, cylindrical, obtuse hairs, spores elliptical 7–8 × 3·5–4μ. Spherical or irregular crystal masses occur in the gill trama.

Type : on small twigs, Cuba, *Wright* 74. Fig. 9.

Marasmius coraciceps *Berk. & Curt.* in J. Linn. Soc. Bot. **10,** 294 (1869).

Pileus almost 3 cm. across, slightly conico-convex, smooth, not striate when dried, closely so at the margin when soaked up, dark reddish-brown ; gills crowded, of three lengths, narrow, adnate ; stipe concolorous with the pileus, hollow, smooth, arising from white mycelial

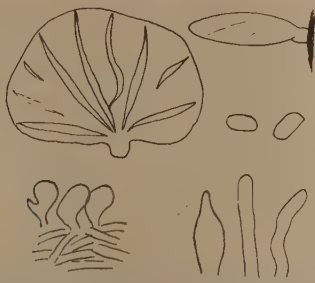

FIG. 9. *Marasmius concolor.* Pileus soaked up sketched from below and from the side × 14, section of pileus surface, cheilocystidia and spores × 660.

strands. There is no specialised pellicle to the pileus, trama hyphae 2–3μ wide, rather loosely woven but cohering in groups in the pileus, very compact with rather thick yellowish walls in the gills, gill edge sterile but no cheilo- or pleurocystidia present, basidia 13 × 3μ, spores not recovered. Fig. 10.

Type : on the ground in forest, Cuba, *Wright* 30.

Superficially this resembles *Collybia detersibilis* but the hyphal structure is probably different, the basidia are smaller and the gills thinner.

Fig. 10. *Marasmius coraciceps*. Pileus soaked up × ⅔, part of gill plan × 10, basidia × 660.

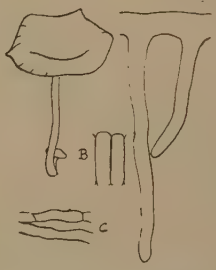

Fig. 11. *Marasmius cyathiformis*. Dry pileus × 1, surface hyphae and basidia × 660.

Marasmius cyathiformis *Berk. & Curt.* in J. Linn. Soc. Bot. **10,** 295 (1869).

Sporophores subcaespitose, on dead wood. Pileus umbilicate, smooth, dark chocolate brown when dry, dark reddish-brown and somewhat translucently striate when soaked up ; gills crowded, of two or three lengths, broad, thin, adnate-decurrent ; stipe concolorous, smooth, longitudinally furrowed when dry. Pileus surface of thinwalled hyphae 2μ wide, trama of similar closely packed hyphae, no cheilo- or pleurocystidia, basidia 12 × 3μ, spores not recovered. The gills are much overgrown with moulds. Fig. 11.

Type : Cuba, *Wright* 84.

Heliomyces decolorans *Berk. & Curt.* in Ann. Mag. Nat. Hist. ser. 3, **4,** 295 (1859).

Pileus now light brown, smooth ; gills subdistant, of two lengths adnate, broad, inter-connected by veins ; stipe now dark brown, smooth, cylindrical. Pileus covered by a thick pellicle of slender hyphae with gelatinised walls, trama of delicate, closely woven, non-gelatinised hyphae ; pleurocystidia abundant, ventricose 40–45 × 10–11μ, conspicuous as minute yellowish hairs when the dried gills are viewed under a lens, no cheilocystidia, basidia about 20 × 3–4μ, a few spores 8–11 × 3·5–4μ occur on the hymenium. Fig. 12.

Type : on rotten wood, Alabama, *Peters* 7.

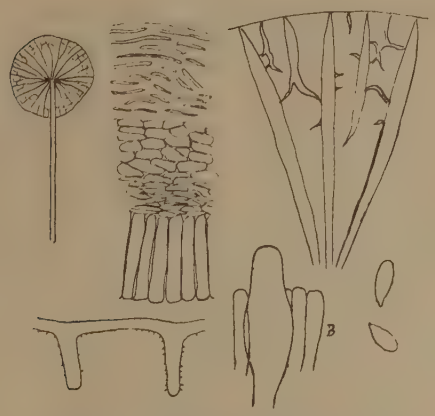

FIG. 12. *Heliomyces decolorans*. Soaked up pileus × 1, part of gill plan × 10. section of pileus, hymenium and spores × 660.

Marasmius decurrens *Mont.* in Ann. Sci. Nat. Bot. Ser. 4, **1,** 118 (1854).

Pileus up to 1 cm. across, convex with a small umbilicus, now yellowish-brown, probably whitish when fresh, striate, smooth ; gills subdistant, of two lengths, decurrent, not interveined ; stipe slender, cylindrical, smooth, up to 2 cm. long, brown. Trama homogeneous, of slender thinwalled hyphae 1·5–2μ wide, loosely woven in a colourless mucilaginous matrix, slightly more compact at the pileus surface, no cystidia, basidia about 20 × 6μ, probably four-spored but no spores recovered. Fig. 13.

Type : French Guiana, *Leprieur* 984.

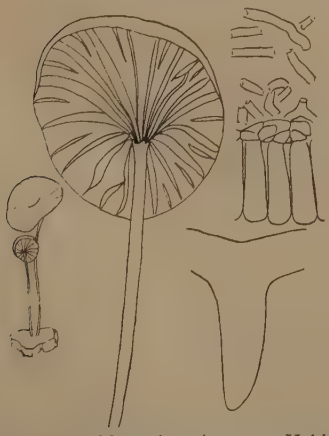

FIG. 13. *Marasmius decurrens*. Habit sketch × 1, dry sporophore × 7, hymenium and adjacent trama × 660.

FIG. 14. *Collybia detersibilis*. Dry sporophores × 1, tramal hyphae, basidium and spores × 660.

Montagne described the species as " ad cortices et folia ". In the type collection at Paris there are many sporophores on bark and only one on the midrib of a leaf. The anatomical data given above are from a sporophore on bark.

Collybia detersibilis (*Berk. & Curt.*) *Sacc.*, Syll. fung. **5,** 247 (1887). *Agaricus detersibilis* Berk. & Curt. in Ann. Mag. Nat. Hist. ser. 2, **12,** 419 (1853).

Pileus up to 12 mm. diameter, convex, dark reddish-brown when dried, the margin closely but obscurely striate ; gills of two lengths, crowded, adnate, narrow ; stipe cylindrical, concolorous, longitudinally furrowed and twisted when dried, surface horny, now overgrown with moulds, pith loosely stuffed, base with a whitish mycelial weft. Tramal hyphae 4–5μ wide, thinwalled, non-amyloid, closely woven, no specialised pellicle to the pileus, no pleurocystidia, gill edge probably sterile but no distinctive cheilocystidia, basidia 22 × 5μ, a few elliptical spores 5 × 2·5–3μ occur on the gills and may belong to the agaric. Fig. 14.

Type : amongst grasses on sandy soil, South Carolina, *Curtis* 3202.

Marasmius dilatatus *Berk.* in Hooker's Journal of Botany, **7,** 138 (1856).

Pileus 9 mm. diameter, flattened, smooth, tawny and translucent when soaked up ; gills crowded, of two or three lengths, narrow, now free but perhaps pulled away from the stipe by contraction on drying ; stipe cylindrical above a bulbous base, smooth, reddish-brown shading to black at the base. Pileus without a specialised pellicle, trama of slender hyphae 1·5μ wide, cohering tightly, perhaps owing to some gelatinisation of their walls, rather pale reddish-brown in Melzer's reagent, no pleurocystidia or marginal hairs, basidia 11 × 3μ, spores not recovered. Fig. 15

Type : on dead twigs, Panuré, Brazil, *Spruce* 93. *Spruce* 109, also cited by Berkeley appears to be the same species.

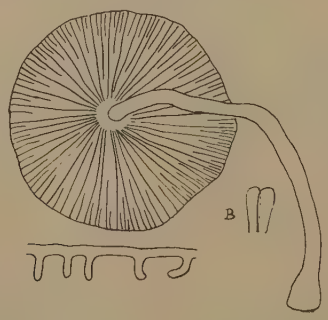

Fig. 15. *Marasmius dilatatus.* Sporophore soaked up × 4, basidia × 660.

Marasmius gamophyllus *Mont.* in Ann. Sci. Nat. Bot. ser. 4, **1,** 116 (1854).

Pileus 5 mm. diameter, expanded, probably brown, smooth : gills subdistant, of two lengths, adnate, not interveined, narrow, thin ; stipe slender, cylindrical, smooth, dark brown. Pileus covered with a dark

brown epidermis of about five to six layers of thinwalled hyphae with coloured contents, underlying trama of hyaline woven hyphae, no pleurocystidia or cheilocystidia, basidia 15 × 4μ, spores non-amyloid. elliptic-fusiform 8–10 × 4μ. Fig. 16.

Types : on fallen leaves, French Guiana, *Leprieur* 997.

The type collection now contains two sporophores, both white with corrosive sublimate. Montagne described the gills as " angustis ochraceo-pallidis adnexis connato-reticulatis ". The apparent forking and reticulation is, however, an artefact, presumably due to faulty drying. Sections show that the gills merely cohere in groups and only slight pressure is required to separate the two hyemnia. It is seldom that one can convict this very reliable and painstaking mycologist of such an error. When one compares Montagne's diagnoses with the contemporary productions of Berkeley one realises how competent Montagne really was.

Marasmius haematodes *Berk. & Curt.* in J. Linn. Soc. Bot. **10,** 299 (1869).

Sporophores solitary, on sticks. Pileus reniform, 2 mm. across, slightly convex, smooth, very soft and flexible when soaked up, reddish-brown ; gills few, distant, of two lengths, free, attenuated at each end, narrow ; stipe a minute lateral tubercle. Tramal hyphae about 2μ wide, pileus surface formed of thinwalled pyriform bodies 4–6μ across, probably swollen hyphal tips, sometimes with a few reddish granules on their walls, no pleuro- or cheilocystidia, basidia 12 × 4μ, probably four-spored. Fig. 17.

Type : Cuba, *Wright* 30.

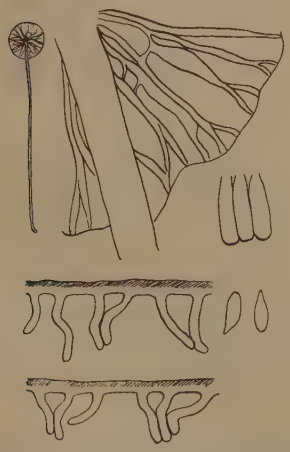

Fig. 16. *Marasmius gamophyllus*. Dry sporophore × 1, part of apparent gill plan × 10, basidia and spores × 660.

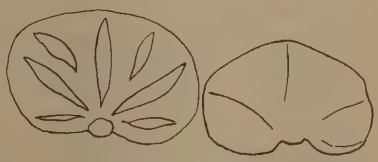

Fig. 17. *Marasmius haematodes*. Soaked up pileus from below and above × 14.

The colour and texture suggest Auriculariaceae but the gills are quite distinct and the basidia are normal homobasidia.

Marasmius holophaeus *Mont.* in Ann. Sci. Nat. Bot. ser. 4, **1,** 110 (1854).

Pileus when dried about 1·5 cm. diameter, expanded, thin, trans-

lucently striate, smooth, light brown ; gills crowded, adnate, narrow, thin, of two or three lengths, not interveined ; stipe cylindrical, dark brown, smooth, hollow. Trama of thinwalled, delicate hyphae about 2μ wide, permeated by scattered vermiform hyphae 7–13μ wide, with contents deeply staining in cotton blue, pleurocystidia scattered, ventricose, thinwalled, not far exceeding the basidia and easily overlooked, cheilocystidia not seen, basidia about 18 × 5μ, four-spored, spores non-amyloid, elliptical, thinwalled, 5–6 × 3–3·5μ. Fig. 18.

Type : among fallen leaves, French Guiana, *Leprieur* 987.

The presence of lacticiferous hyphae in the trama suggests comparison with *Collybia cycadicola* Josserand, the type species of *Lactocollybia* Singer, which is common in Trinidad. This fungus has somewhat pip-shaped spores 7–9 × 5μ when freshly shed and delicate capitate hairs on the gill edge. The spores, however, collapse when dried and it seems not unlikely the marginal hairs might be very difficult to recover after 100 years in a herbarium packet. Macroscopically the types of *M. holophaeus* look very like dried *C. cycadicola* and I suspect they are in fact the same species.

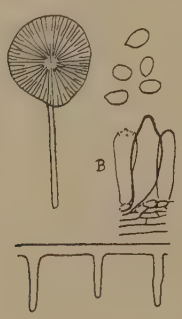

Fig. 18. *Marasmius holophaeus*. Dry sporophore × 1, hymenium and spores × 660.

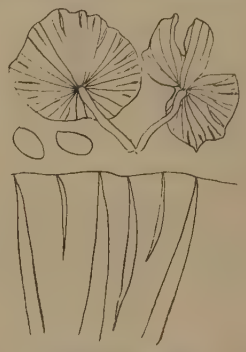

Fig. 19. *Marasmius inoderma*. Dry pilei × 1, part of gill plan × 5, spores × 660.

Marasmius inoderma *Berk.* in Hooker's Journal of Botany, **3,** 15 (1851).

Pileus about 2 cm. across, convex, yellowish, probably originally white ; gills subdistant, of two or three lengths, adnate, broad, thin, not interveined ; stipe cylindrical, smooth, concolorous. Trama thin, of loosely woven thinwalled hyphae, not gelatinised, non-amyloid, no pleurocystidia, gill edge not recovered, spores broadly elliptical 8–9 × 5μ. Fig. 19.

Type : Para, *Spruce*.

Evidently this is an earlier name for *M. semi-ustus* Berk. & Curt. as usually interpreted, or for *M. sabali* Berk. but in the absence of the characteristic cheilocystidia one cannot be sure which species is present.

Collybia ixodes (*Mont.*) *Sacc.*, Syll. Fung. **5,** 232 (1887).

Agaricus ixodes Mont. in Ann. Sci. Nat. Bot. ser. 4, **1,** 95 (1854).

Pileus when soaked up about 2 cm. diameter, convex, depressed at the disc, becoming thin, translucent, wood brown when dried, smooth ; gills crowded, of two lengths, very narrow, adnate ; stipe 2 cm. × 2 mm.,

cylindrical, smooth, dark purplish-brown when dried. Trama homogeneous, of hyaline, loosely woven hyphae 2–3μ wide, embedded in a colourless gelatinous matrix, no specialised pellicle to the pileus, no pleurocystidia, gill edge of short parallel hairs scarcely distinguishable from the hymenium, basidia 12 × 3μ, spores not recovered. Fig. 20.

Type : on dead wood, French Guiana, *Leprieur* 982.

It should be noted that though Saccardo compiled the pileus as "¼ mm. lat." this was a misunderstanding of Montagne's diagnosis which runs : " Pileus . . . vix ¼ millim. crassus " and gives the size correctly as " sesquicentem diam.", i.e. 1·5 cm. in the dried state.

Fig. 20. *Collybia ixodes*. Soaked up sporophore × 1, part of gill plan × 10, basidia and tramal hyphae × 660.

Marasmius longipes *Mont.* in Ann. Sci. Nat. Bot. ser. 4, **1,** 114 (1854).

Pileus 2–3·5 cm. across, expanded, somewhat depressed at the disc, closely striate-sulcate, drying ochraceous ; gills somewhat crowded, broad, adnate, not interveined ; stipe elongated, cylindrical, up to 7 cm. × 2 mm., downy or fibrillosely hairy. Pileus surface of woven hyphae, trama non-gelatinised, no cystidia, spores not recovered.

Type : on decaying fallen leaves, French Guiana, *Leprieur* 973.

Montagne described the spores as spherical, 3·5μ across but these were probably mould spores. The species probably belongs in *Collybia* but there is already a *C. longipes* (Bull. ex Fr.) Quel. A Trinidad collection which seems identical with *M. longipes* is Dennis 33, on fallen leaves of Theobroma, River Estate, Diego Martin, 22.ix.1949, which is illustrated in Fig. 21 and described below to supplement the data recoverable from the type.

Pileus 2–4·5 cm., convex then expanded or depressed, with a shallow umbilicus, sulcate-striate almost to the disc, russet, drying various shades from cinnamon-buff to warm sepia in the same collection ; gills rather crowded, of five lengths, up to 3 mm. wide, not interveined, cinnamon-buff, edge finely denticulate ; stipe up to 7 cm. × 3 mm., concolorous, clothed with velvety, hyaline, undulating, obtuse, thin-walled hairs, the base seated on a whitish mycelial weft. Pileus surface of interwoven hyphae 4–5μ wide, tramal hyphae similar, about 4μ wide, closely woven, no pleurocystidia, gill edge sterile but lacking distinctive

FIG. 21. *Marasmius longipes*. Fresh sporophore and section × 1, section of gill edge and spores × 660, all from Dennis 33.

hairs, basidia cylindrical, about 20 × 4μ, spores slightly pip-shaped, non-amyloid, white in the mass 7–8 × 3–3·5μ.

M. longipes differs from *M. subpruinosus* Murr. in its pileus with closer, longer striae, without the latter's downcurved margin and in growing on leaves.

Collybia nigrita (*Berk. & Curt.*) *Sacc.*, Syll. Fung. **5,** 225 (1887).

Agaricus nigritus Berk. & Curt. in J. Linn. Soc. Bot. **10,** 285 (1869).

Gymnopus nigrita (Berk. & Curt.) Murr. N. Amer. Flora 9, 373, 1916.

Pileus about 1 cm. diameter, convex with persistently inrolled margin, black, yielding a dark brown stain in KOH solution, flexible and subgelatinous when soaked up ; gills crowded, narrow, of three or more lengths, adnate ; stipe slightly attenuated upwards, smooth. Pileus surface a single layer of hymeniform cells about 3μ diameter, trama of very slender hyphae, about 1μ wide, stained in cotton blue, embedded in a colourless matrix, permeated by scattered vermiform hyphae up to 7μ wide whose tips occasionally penetrate the hymenium as inconspicuous gloecystidia, no pleurocystidia or distinctive hairs on the gill edge, basidia about 15 × 3μ, spores not recovered. Fig. 22.

Type : gregarious on wood, Cuba, *Wright* 56.

Murrill believes he has this fungus from Jamaica and Mexico and states the pileus to be greyish white to fuliginous when fresh, with spores 5–6 × 4·5–5·5μ. Since he cites as a synonym *Collybia irrorata* Pat., a fungus described with abundant cystidia 50–70 × 15–20μ his opinions cannot be accepted without independent confirmation.

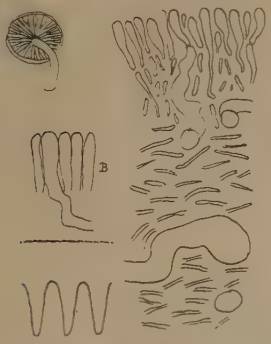

FIG. 22. *Collybia nigrita.* Sporophore soaked up × 1, Section of pileus surface and hymenium × 660.

Marasmius obliquus *Berk. & Curt.* in J. Linn. Soc. Bot. **10,** 299 (1869).

Pileus up to 1·5 cm. across, flattened, smooth, now very dark brown but probably originally light coloured ; gills subdistant, of two lengths, rather broad, slightly decurrent ; stipe short, cylindrical, excentric, smooth. Trama homogeneous, of hyphae 2μ wide in a gelatinous matrix, pileus surface of similar woven hyphae, no pleurocystidia, gill edge of sterile hyphal tips without distinctive hairs, basidia 3–4μ wide, probably 4-spored but spores not certainly identified because of the copious growth of moulds. Fig. 23.

Type : on wood, Cuba, *Wright* 40.

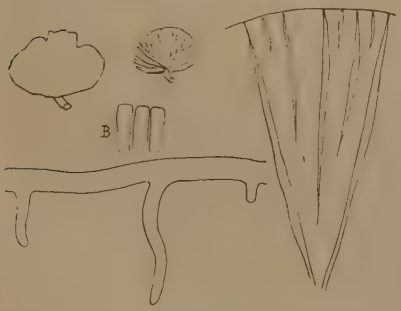

FIG. 23. *Marasmius obliquus.* Soaked up sporophores × 1, part of gill plan × 10, basidia × 660.

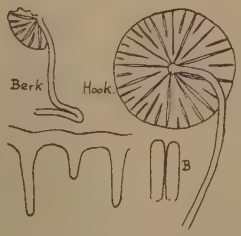

FIG. 24. *Marasmius obscurus.* Soaked up sporophores × 2½, basidia × 660.

Marasmius obscurus *Berk.* in Hooker's Journal of Botany, **8,** 139 (1856).

Pileus up to 7·5 mm. diameter, convex, expanded, yellowish and translucent when soaked up, smooth ; gills subdistant, of three lengths, adnate, not interveined ; stipe slender, dark reddish brown, smooth, minutely downy near the base. Trama non-gelatinised, of closely woven, thin-walled hyphae 3–4μ wide, pileus surface of similar hyphae,

no pleurocystidia or hairs on the gill edge, basidia 15 × 3–4μ, spores not recovered. Fig. 24.

Type : on fallen leaves, Panuré, Brazil, Feb. 1853, *Spruce* 138.

The collector's note reads : " Griseo-subluteus (pileus in specim. minor, brunnescens, hymenium albidum)". Spruce 138 is represented in Herb. Kew. by one example ex Herb. Berkeley and one ex Herb. Hooker. The former bears one small broken pileus attached to a leaf margin, some abortive sporophores and another small pileus glued to the paper. The latter carries one much larger sporophore attached to the mid-rib of a leaf. In spite of the difference in size I believe these are all the same species but all details given above except pileus diameter are taken from the small pileus in Herb. Berkeley.

Marasmius petiolorum *Berk. & Curt.* in J. Linn. Soc. Bot., **10,** 296 (1869).

Pileus about 1 mm. diameter, convex with a slight umbo, sulcate-striate, probably originally white throughout ; gills distant, rather broad, arcuate, adnate, of two lengths ; stipe cylindrical above a slightly swollen base, smooth in lens view. Pileus surface of thin-walled hyphae 4–5μ wide with short brush-like processes on their upper surface, trama of broad, tubular, thin-walled hyphae 6–9μ wide, no pleurocystidia, gill edge much obscured by moulds but probably with delicate, pyriform cystides-en-brosse, cells of the upper part of the stipe covered with minute short processes, spores cylindrical 6–7 × 2μ, lying in pairs on the hymenium, basidia 15 × 4μ, sterigmata not seen. Fig. 25.

Type : in swarms on a petiole and midrib of fallen leaf, also apparently on sticks, Cuba, *Wright* 140.

The structure recalls that of *Mycena corticola* and as the species seems now to be adequately characterised I propose to transfer it to *Mycena* as *M. petiolorum* (Berk. & Curt.) comb. nov.

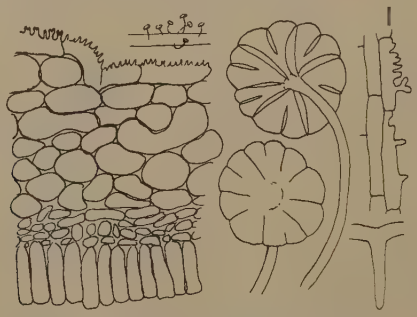

Fig. 25. *Marasmius petiolorum.* Habit sketch × 1, soaked up sporophore from above and below × 20, section of pileus and cells from upper part of stipe × 660.

Marasmius pulchellus *Berk.* in Hooker's Journal of Botany, **8,** 138 (1856).

Pileus convex, 1 cm. diameter, pellucidly striate, now tawny when soaked up, smooth ; gills crowded, of two or three lengths, narrow, adnate, not interveined ; stipe smooth, cylindrical, reddish-brown,

darker below. Pileus surface of parallel, radiating, thin-walled hyphae 5μ wide, trama of very slender hyphae 1·-1·5μ wide with yellowish walls, basidia 10 × 2·5μ, no cystidia, spores not recovered. Fig. 26.

Type : on dead leaves, Panuré, Brazil, *Spruce* 99.

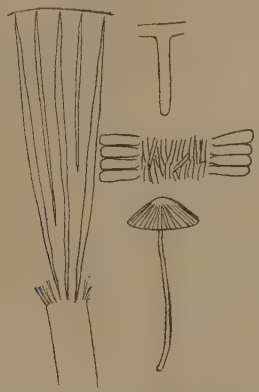

Fig. 26. *Marasmius pulchellus*. Soaked up sporophore × 1, part of gill plan × 10, hymenia and gill trama × 660.

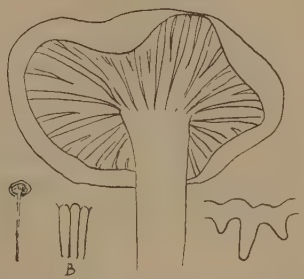

Fig. 27. *Marasmius rugatus*. Dry sporophore × 1, soaked up pileus × 7, basidia × 660.

Marasmius rubellus *Mont.* in Ann. Sci. Nat. Bot. ser. 4, **1,** 115 (1854).

Of the type collection at Paris, on fallen leaves in forests, French Guiana, *Leprieur* 993, only a few fragments remain and I can add nothing of value to Montagne's rather full diagnosis.

Marasmius rugatus *Mont.* in Ann. Sci. Nat. Bot. ser. 4, **1,** 109 (1854).

Pileus 3 mm. diameter, convex, umbilicate, margin inrolled, smooth ; gills rather crowded, narrow, adnate, of two lengths ; stipe slender, cylindrical, smooth. Trama of slender, closely woven hyphae 2–3μ wide, pileus without a specialised pellicle, no cystidia, basidia 12 × 2·5μ, spores not recovered. Fig. 27.

Type : gregarious on dead wood, French Guiana, *Leprieur* 969. The sporophores are probably immature, covered with moulds and it will be difficult to recognise the species again.

Marasmius sarmentosus *Berk.* in London Journal of Botany, **5,** 2 (1846).

Pileus 3 mm. diameter, convex with a prominent pointed umbo, dull dark brown with adpressed whitish hairs cohering in imbricated pointed squamules ; stipe slender, wiry, clothed with similar hairs, branched a little below the pileus. Hairs of the pileus 3–4μ wide, with thick hyaline walls stained deep red-brown in Melzer's reagent, apex acute, lumen very narrow, non-septate ; cystidia and spores not recovered. Berkeley noted in his diagnosis that the gills had all been destroyed by insects before the collection reached him. The sporophores arise from the midribs of fallen leaves and are associated with shaggy, wiry rhizomorphs up to 20 cm. long. Fig. 28.

Type : Jamaica, *Purdie*.

It seems possible that this is merely a branched, rhizomorphic state of *Crinipellis stupparia* (Berk. & Curt.) Pat. but no definite conclusion can be arrived at until fresh collections are available showing the cheilocystidia and spores.

Fig. 28. *Marasmius sarmentosus*. Habit sketch × 1, pilei × 14, hair × 660.

Marasmius semisparsus *Berk.* in J. Linn. Soc. Bot., **15,** 50 (1877).

Pileus 5 mm. diameter, convex, slightly umbilicate, dark reddish-brown and pellucidly striate when soaked up ; gills crowded, of three lengths, narrow, the shorter gills sometimes confluent with the longer ; stipe slender, smooth, dark brown, about 12 × ¼ mm. Trama of closely packed slender hyaline hyphae, apparently with some gelatinous matrix, no specialised pellicle to the pileus, no cystidia, basidia 14 × 3μ, spores not recovered. Fig. 29.

Type : on petioles of fallen leaf, Bahia, Brazil, Challenger Expedition, Sept. 1873.

Note : not from Bermuda as stated by Saccardo in Syll. Fung. **5,** 563 (1887).

Maramius spaniophyllus *Berk.* in London Journal of Botany **2,** 631 (1843).

Pileus 4 mm. diameter, convex, upper surface chestnut, finely dotted darker as seen under a lens, under surface and gills honey colour ; gills distant, about 6, not interveined, narrow ; stipe short, excentric, becoming lateral. Pileus surface covered with dark-brown, somewhat pyriform cells, some smooth, others crowned by a few short processes, trama of loosely woven, hyaline, slender hyphae, yellowish in Melzer's reagent, basidia 24 × 6μ, spores non-amyloid, elliptical, 7–10 × 4–5μ, no pleurocystidia. Fig. 30.

Type : gregarious and erumpent from the bark of branches, Natividade, Minas Geraes, Brazil, *Gardner*, Nov. 1839.

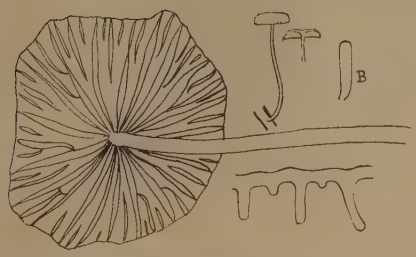

FIG. 29. *Marasmius semisparsus*. Soaked up sporophore and section × 1, pileus from below × 8, basidium × 660.

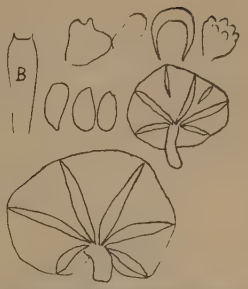

FIG. 30. *Marasmius spaniophyllus*. Soaked up pilei × 7, basidium, spores and pilocystidia × 660.

Heliomyces sprucei *Berk.* in Hooker's Journal of Botany **8,** 134 (1856).

Pileus 2 cm. diameter, convex, umbilicate, vinaceous russet when dry, marked by paler slightly sulcate striae, smooth ; gills rather broad, distant, of two lengths, not interveined ; stipe now approximately orange cinnamon, darker towards the base, with a scurfy fibrous surface of coherent hyaline hyphae 4μ wide. Pileus surface of hyphae 5μ wide, trama of compact hyphae 4–5μ wide with slender lumen staining in cotton blue and thick apparently somewhat gelatinised walls, no pleurocystidia, gill edge sterile but without hairs, basidia 20 × 5μ, spores not recovered.

Type : on sticks, Panuré, Brazil. *Spruce* 91. Fig. 31.

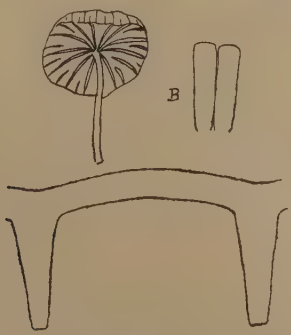

FIG. 31. *Heliomyces sprucei*. Dry pileus × 1, basidia × 660.

Marasmius stenophyllus *Mont.* in Ann. Sci. Nat. Bot. ser. 4, **1,** 116 (1854).

Pileus convex, very thin, about 1 cm. diameter, " albo lacteus " according to the collector's note, smooth, rather distantly striate-sulcate to the centre ; gills distant, of two or three lengths, narrow ; stipe cylindrical, smooth. Pileus surface of hyaline hyphae 4μ wide, trama of more slender hyphae, apparently with gelatinised walls, no cystidia, spores not recovered. The whole collection, both the part in Montagne's herbarium at Paris and that sent by him to Berkeley and now at Kew, is in very bad condition and its structure remains obscure to me. Fig. 32.

Type : on bark of branches, French Guiana, *Leprieur* 1902.

Murrill thought this the same fungus as *M. semi-ustus* Berk. & Curt. He may have been right but I do not feel sufficient confidence in his opinion to adopt *M. stenophyllus* as the name for that common species, especially as Murrill added to the synonymy *M. tenerrimus* which has elongated tear-shaped spores, see below.

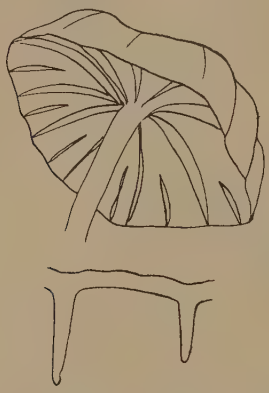

Fig. 32. *Marasmius stenophyllus*. Sporophore × 5.

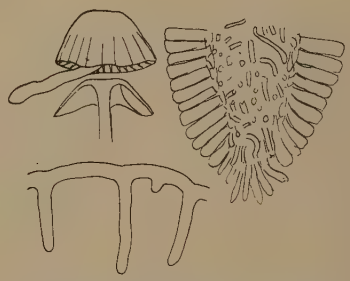

Fig. 33. *Marasmius subglobosus*. Soaked up sporophore and section × 3, section of gill edge × 660.

Marasmius subglobosus *Berk. & Curt.* in J. Linn. Soc. Bot. **10,** 295 (1869).

Pileus 4 mm. diameter, campanulate, striate, smooth ; gills broad, rather crowded, broadly adnate, with a decurrent tooth, of two lengths, not interveined ; stipe cylindrical, smooth. Pileus surface covered with a single layer of non-gelatinised hyphae, trama of very slender hyphae embedded in colourless mucilage, subhymenium thick, nongelatinised, reddish-brown in Melzer's reagent, no pleurocystidia, cheilocystidia delicate, irregularly clavate hairs, basidia about 12 × 3μ, spores not recovered. Fig. 33.

Type : Cuba, *Wright* 20.

This is probably an earlier name for *Omphalopsis roriduliformis* Murrill.

Marasmius tenebrarum *Berk. & Curt.* in J. Linn. Soc. Bot. **10,** 294 (1869).

Pileus hemispherical, umbilicate, smooth, light brown, translucently striate when soaked up ; gills rather crowded, narrow, of two to three lengths, adnato-decurrent, concolorous ; stipe smooth, solid, whitish. Pileus surface of slender hyphae, tramal hyphae similar, 3μ wide, firmly coherent, no pleuro- or cheilocystidia, basidia 15 × 4–5μ, 4-spored, spores that probably belong to this fungus are narrowly elliptical 5 × 2μ. Fig. 34.

Type : on sticks in woods, December, Cuba, *Wright* 108.

Marasmius tenerrimus *Berk. & Curt.* in J. Linn. Soc. Bot. **10,** 296 (1869).

Pileus thin, soft, white ; gills distant, broad, thin, of two lengths, not

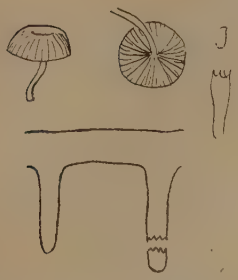

FIG. 34. *Marasmius tenebrarum.* Soaked up sporophore × 1, basidium and spore × 660.

FIG. 35. Spores from type of *Marasmius tenerrimus*, × 660.

interveined ; stipe smooth, hollow, base slightly swollen, now dark brown but the teased out hyphae are only pale yellowish and it may have been white when fresh. Pileus surface of loosely woven, rather broad, hyaline, thin-walled hyphae, tramal hyphae similar, non-gelatinised, no pleurocystidia, gill edge much damaged but there may have been delicate cylindrical hairs, spores tear-shaped, non-amyloid, 13–15 × 4μ. Fig. 35.

Type : gregarious on rotten wood, Cuba, *Wright* 139.

The collection is very poorly preserved but it is probably to be identified either with *M. cubensis* Berk. & Curt. or *Mycena longicystis* Heim, which differ mainly in their gill edges.

Marasmius tomentellus *Berk. & Curt.* in J. Linn. Soc. Bot. **10,** 298 (1869).

Pileus 2 mm. diameter, originally white, hemispherical, closely sulcate-striate, smooth ; gills of two lengths, narrow, adnate, not interveined ; stipe short, wiry, downy throughout, arising from a similar long, wiry, hairy rhizomorph. Pileus surface difficult to examine because of the dense growth of moulds but apparently not of cystides-en-brosse, trama very thin, of delicate non-gelatinised, non-amyloid hyphae, no pleurocystidia, gill edge not seen, spores not recovered. The hairs of stipe and rhizomorph are thick-walled and hyaline. Fig. 36.

Type : Cuba, *Wright* 22.

In spite of the poor condition of the type this species seems distinctive enough to be recognised again and discussion of its affinities may be postponed until fresh collections are available.

Marasmius tortipes *Berk. & Curt.* in J. Linn. Soc. Bot. **10,** 298 (1869).

Pileus about 2 cm. diameter, convex or expanded, smooth, sulcate-striate to the disc, dark reddish-brown and translucent when soaked up, dark olive-brown when dried ; gills distant, narrow, equal, adnate ; stipe long, slightly attenuated upwards, hollow, smooth and polished except at the base which is sheathed with white mycelium, dark reddish-brown. Pileus surface not well seen but probably of large, thin-walled, isodiametric cells, trama thin, of closely woven delicate, non-gelatinised hyphae, turning dark red-brown in Melzer's reagent ; no cystidia, basidia about 40 × 5μ, spores not recovered. Fig. 37.

Type : on sticks, Cuba, *Wright* 156. The species seems closely allied to *M. niveus* Mont.

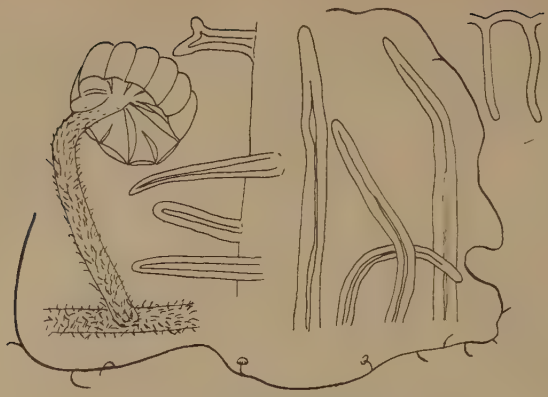

Fig. 36. *Marasmius tomentellus.* Habit sketch × 1, soaked up sporophore × 10, hairs of stipe (left) and Rizomorph (right) × 660.

Marasmius traganus *Berk. & Cooke* in J. Linn. Soc. Bot. **15,** 372, (1876).

Pileus 8 mm. diameter, hemispherical, white, drying yellowish-brown, smooth, striate, translucent when soaked up ; gills rather crowded, of three lengths, 1 mm. wide, occasionally interconnected, broadly adnate ; stipe short, slender, smooth, white. The entire trama is composed of loosely woven slender hyphae in a colourless gelatinous matrix, there is no

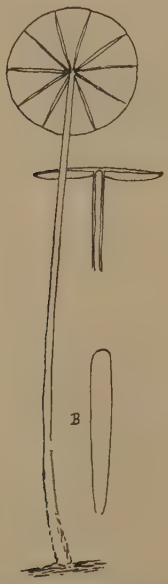

Fig. 37. *Marasmius tortipes.* Soaked up sporophore and section × 1, basidium × 660.

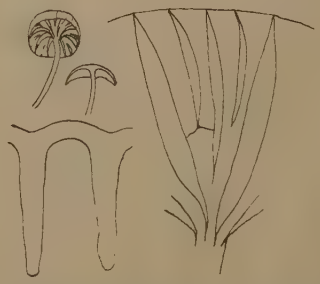

Fig. 38. *Marasmius traganus.* Soaked up sporophore and section × 1, part of gill plan × 10.

specialised pellicle and no pleuro- or cheilocystidia though the gill edge is sterile, spores not recovered. Fig. 38.

Type: on dead stick, Lago serrado, R. Jurua, Brazil, 30 Oct. 1874, *Trail* 62.

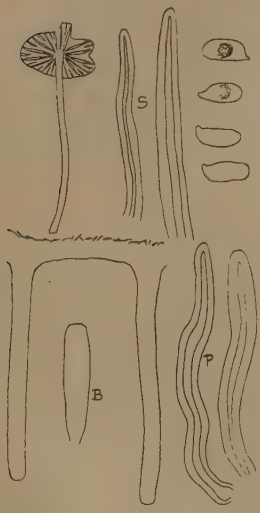

FIG. 39. *Collybia urbica*. Soaked up sporophore × 1, hairs of stipe (S) and pileus (P), spores and basidium × 660.

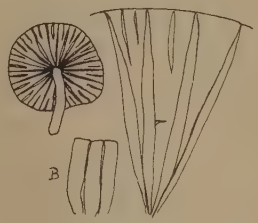

FIG. 40. *Marasmius viticola*. Soaked up pileus × 1, part of gill plan × 5, basidia × 660.

Collybia urbica (*Mont.*) *Sacc.*, Syll. Fung. **5,** 218 (1887).

Agaricus urbicus Mont. in Ann. Sci. Nat. Bot. ser. 4, **1,** p. 94, 1854.

Pileus about 13 mm. diameter, expanded, covered with adpressed hairs, colour completely obscured by a deposit of corrosive sublimate ; gills subdistant, of two lengths, attenuated at each end, adnate, not interveined, rather broad ; stipe cylindrical, 3 cm. × 1·5 mm., hairy like the pileus. Hairs of the pileus about 60 × 5μ, undulating, obtuse, non-septate, with thick walls reddish-brown in Melzer's reagent and slender lumen, those of the stipe similar. Trama of thin-walled, closely packed hyphae, slightly reddish in Melzer's reagent, no pleurocystidia, gill edge rounded, apparently occupied by sterile basidium-like cells, basidia about 30 × 7μ, spores broadly elliptical with a large granular body in the centre, 10–11 × 4–5μ. Fig. 39.

Type : on sandy soil, Cayenne, French Guiana, *Leprieur* 989.

Clearly this is a good species of *Crinipellis*, very probably the same as *C. subtomentosa* (Peck), Singer, and I propose to transfer it to that genus as *C. urbica* (Mont.) comb. nov. As with most of Leprieur's collections the poisoning was evidently done before it reached Montagne's hands. Nevertheless he recognised the affinity of *A. urbicus* with *A. stipitarius*, the type species of *Crinipellis*, a remarkable example for his day of careful and critical examination of poorly preserved material.

Marasmius viticola *Berk. & Curt.* in Ann. Mag. Nat. Hist. ser. 3, **4,** 295 (1859).

Pileus about 1·5 cm. diameter, convex, smooth, white, translucent and

sulcate-striate when soaked up ; gills subdistant, of two or three lengths, adnate, not interveined ; stipe up to 2 cm. × 1·5 mm., dark-brown with white flesh, appearing finely downy above but this is largely, perhaps wholly, due to mould growth. Pileus surface formed of closely woven hyphae, trama of similar hyphae 3–5μ wide, loosely woven in a colourless gelatinous matrix, no cystidia, the gill edge appears fertile, basidia 17 × 4μ, spores not recovered. Fig. 40.

Type : on branches of *Vitis*, Alabama, *Peters* 4604.

This species should be compared with *Omphalopsis distantifolia* Murrill.

Horticultural Biography. The English have been described as a nation of gardeners, in addition to their genius for shop-keeping and poetry. If these generalizations be true it could be suggested that they are somewhat better balanced than most other nations. On the other hand, a complaint has been raised that our great gardeners have been given little attention, or have been entirely ignored, in The Dictionary of National Biography. The book* here reviewed outlines the lives and considers many of the horticultural activities of John Claudius Loudon, William Robinson, and Reginald Farrer. On the whole, it is well and interestingly written, apart from several passages that could have been much improved by reconstruction or judicious pruning. The subjects selected for biographical treatment contrast as human beings even more than they do as gardeners. By birth, Loudon was a Scotsman and Robinson an Irishman, while Farrer hailed from Yorkshire. By adoption, all three are claimed as English. Loudon was happily married, the other two remained bachelors. All three were hard workers and voluminous writers. There is little doubt that Loudon had the most generally likeable character which contrasted with the irritability and inconsistency of Robinson and the exuberance and wit of Farrer. That all three, along their own different lines, did much for English gardens is clearly demonstrated by concise summaries of their activities and by extracts from their published works. Robinson's criticisms of bedding out at Kew did not stop the practice but many other gardens have developed in more interesting and beautiful ways as a result of his preaching. Mixed with Farrer's verbosity is much practical experience of the growing of plants in rock gardens.

For the most part, Mr. Taylor devotes his attention to biographical history without attempting to give advice to present-day gardeners. It may, however, be noted that the scientific pendulum has swung to and fro regarding the value of earthworms as factors increasing soil fertility. His statements that for any lawn " the best fertilisers are wet and worms " and that " Worms cultivate the soil to an incredible extent " are at least an over-statement and scarcely in accord with some of the expert views in this country.

It is a pity that this interesting book has no index.

W. B. Turrill.

*Some Nineteenth Century Gardeners. By Geoffrey Taylor. Sheffington, 1951. Price 9/6.

SUPPLEMENTARY NOTES ON CREPIS V.

SOME SPECIES OF TROPICAL AND SOUTH AFRICA.

Ernest B. Babcock.

In connection with the two floras of Tropical Africa which are in preparation at Kew, the writer was asked to identify a number of specimens of *Crepis*. Some of these specimens provide valuable information on the morphological characters, the variability and the geographic distribution of these little known species. The herbaria represented, with their abbreviations in parentheses, are as follows : East African Herbarium, East African Agriculture and Forestry Research Organization, Nairobi, Kenya Colony (EA) ; Forest Herbarium Ibadan, The Chief Conservator of Forests, Ibadan, Nigeria (FHI) ; The Herbarium, Royal Botanic Gardens, Kew (K) ; Herbarium, University of California, Berkeley (UC) ; Stockholm, Naturhistoriska Riksmuseet (S). Earlier papers published as " Supplementary Notes " to the monograph on *Crepis* (Babcock, 1947 *a*, *b*) are cited in number IV of this series (1951). Taxonomic information on individual species will be found only in numbers I and IV ; numbers II and III deal with certain phylogenetic problems.

C. bruceae Babc. Two collections can now be cited in addition to the original one (1947 *b*, 401) : *Schlieben* 3503 (S) Tanganyika Territory : Morogoro distr., Uluguru Mts., west side, savanna above the mist forest, 2400 m., February 19, 1933, flowers and fruits. " Sporadic (or isolated), abundant in marshy places ". *Rounce 576* (EA) Morogoro distr., July 16, 1937, flowers and immature achenes. In the latter specimen the inner involucral bracts are slightly spongy-thickened at the base.

Crepis cameroonica Babc. Specimens collected at elevations of 2583 and 3355 meters on Mt. Cameroon differ strikingly in stature and more or less in certain other characters (see minor variant no. 1 described below). *R. W. J. Keay 28585* (UC, K, FHI) Cameroon Mt., below hut 2, grassland between rocks, 2583 m. is typical ; *Keay 28608* (UC, K, FHI) Cameroon Mt., between huts 2 and 3, grassland, 3355 m. The latter is minor variant no. 1. : plants 1–2 dm. high ; caudical leaves 4–7 cm. long, shortly petiolate ; stem 1–4-headed ; peduncles 1·5–5 cm. long ; longest outer involucral bracts $\frac{2}{3}$ as long as inner ones ; inner involucral bracts, florets and achenes typical. A repressed form caused by high altitude. Other specimens, all corresponding to the above description and all collected from about 2900 to 4000 meters altitude, are : *Migeod 199* (K) ; *T.D.M. 1243* (K) ; *Steele 3* (K) ; *Dalziel 8312* (K) ; *Hutchinson and Metcalfe 57* (K) ; The following are typical specimens from lower altitudes : *T.D.M. 848, 888, 1002* (K) ; *Carpenter 134* (K)

C. carbonaria Sch. Bip. Part of a collection, *Greenway 3733a* (K), not previously seen by me, agrees with the portion previously cited (1947 *b*, 352) even to the obscure cornicles near the apex of the inner involucral bracts. Also one of the four plants in this part of the collection bears mature achenes which are dark brown, 5·5–6 mm. long, 0·8 mm. wide, with a coarse beak about 1 mm. long, 10-ribbed, the ribs nearly equal.

The plants in this part of no. 3733 *a* have unusually small leaves, the basal ones being only 2–4 cm. long, the cauline ones, bract-like. Kilimanjaro, Peter's Hut, 3726 m., strong slopes with *Alchemilla* and *Blaeria silvatica*.

A single specimen from Mt. Elgon establishes an important extension to the known geographic range of this species and again raises the question whether distinct subspecies exist on Kilimanjaro and Elgon. As in the Kilimanjaro plants, the leaves are small but the florets and achenes are larger than in typical plants, the florets being about 10 mm. long and the achenes, 6–6·5 mm., dark brown in colour but pale yellowish near the apex. No cornicles were observed on the inner involucral bracts. Thus distinctive differences exist between the Kilimanjaro and Elgon plants and between these and typical plants. But, until more material is available from both mountains, the recognition of subspecies should wait. Uganda : Mt. Elgon, Bulambuli, in grass, 2745 m., *Tothill 2295* (K).

C. congoensis Babc. One plant, *de Witte 377* (K) Belgian Congo : Baudouinville, is the second collection of this species known to the writer. The only notable departure from the type is found in the fewer (9–10) outer involucral bracts. This plant, with flowers and fruits, was collected April 19, 1931 whereas the type was collected in October. From the type locality (Elisabethville) Baudouinville is located about 600 kilometers to the northeast, near the shore of Lake Tanganyika.

C. ellenbeckii R. E. Fr., m.v.7. One collection, *Napier 5386=2997* (K, EA) Kenya Colony : Kisii, hillside grassland, about 1600 m., adds another minor variant to the six already noted (1947 *b* : 353–355) in this highly variable species, and this is the *first* collection in which mature achenes have been observed.

Caudical leaves 5–8 cm. long, 1–2 cm. wide, sparsely setulose ; stems exceeding the caudical leaves, 1–2-headed ; peduncles fuscous-tomentose, pubescent with fine gland-hairs ; involucre 9–12 mm. long, 4 mm. wide, the inner bracts pubescent with fine black gland-hairs ; corolla 7–9 mm. long ; anther tube 2–3 mm. long ; achenes (nearly mature) pale brown tinged dark purple at summit, 5·5 mm. long, 0·7 mm. wide, columnar, constricted at the yellow-calloused base, gradually attenuate to the 3 mm. wide summit, constricted below the white expanded pappus disk, 18–20-ribbed, ribs unequal, with 3–5 stronger ones, rounded, muriculate ; pappus dusky white, 5 mm. long, 2-seriate.

Another collection, *Greenway* in 1946 (K) Tanganyika Terr. : Northern Prov., Mbulu distr., Mt. Hanang, crest of a rocky peak in moorland, 3416 m., resembles minor variant no. 6 (1947 *b*, 355) in having the corolla tube scabridulous ; but the corolla is 9 instead of 11 mm. long, the anther tube is 2·5 mm. long, and the outer involucral bracts are ¾ as long as the inner ones. There are no achenes. Variability in the flower parts seems to be characteristic of this species.

C. hypochaeridea (DC.) Thell. subsp. *genuina* (Thell.) Babc. Two collections provide new localities for this subspecies : *Wylie* in 1931 (K) Natal : Greytown ; *Bradfield 213* (K) Transvaal : Benoni.

C. hypochaeridea (DC.) Thell. subsp. *rhodesica* Babc. Five collections from new localities in Southern Rhodesia : *Collins 16* (K) Injina distr., Marandellas, 1373 m. ; *Wild 1349* (K) Inyanga distr., 2044 m. ; *Eyles 7197* (K) near Salisbury ; *Eyles 8467* (K) Inyanga, 1830 m. ; *Wild 2071* (K) Chirinda distr., 1160 m.

C. hypochaeridea (DC.) Thell. subsp. *brevicaulis* Babc. In addition to two isotypes in Herb. Kew., three other collections of this little known subspecies were seen : *Rogers 19021* (S) Transvaal : Pietersburg distr., 1200 m. ; *Hutchinson and Gillett 4205, 4206a* (K) N. Transvaal : Zoutpansberg, 1220 m.

C. kilimandscharica O. Hoffm. Two collections, *Greenway 3917* and *Rogers 441*, extend the altitudinal range for this species from 2700–3500 to 2675–3750 m., the higher limit given by Greenway along with the following notes : " Growing on mossy banks in association with *Viola Eminii* in *Philippia excelsa-Hagenia abyssinica* woodland ; not very common ".

C. newii Oliv. et Hiern subsp. *greenwayi* Babc. The third reported collection of this subspecies, *Greenway 7575* (K) Tanganyika Territory : Northern Prov., southern Mbulu distr., Mt. Hanang, Nangwa, 2044 m., extends its known distributional area about 500 kilometers northward from the type region. The collector reports it as up to 1·5 dm. high and " very locally common but scattered, with *Senecio bupleuroides* in *Themeda triandra, Exotheca abyssinica, Solanum, Lippia asperifolia* grassland, on a reddish brown loam of volcanic origin on the foot-slopes of the mountain". The few heads are shortly pedunculate and arranged in a close cyme terminating the simple or 1-furcate stem. Collected February 4, 1916, flowers and young fruits.

C. newii Oliv. et Hiern, subsp. *tundensis* Babc. Four collections add new localities to the two already known for this subspecies : *Maitland 1469* (K) Southeast Nigeria : Bamenda, Belo, 1373 m. ; *Maitland 1678* (K) Bamenda, Lakina, 1830 m. ; *Migeod 443* (K) above Bamenda, 1983 m. ; *Keay 28384* (UC, K, FHI) Bamenda, Bafut-Ngemba F.R., by nursery, on recently cleared fire trace with bracken, 1830 m. From these specimens it appears that the flowering and fruiting period for this subspecies extends from January to April.

C. newii Oliv. et Hiern subsp. **mbuluensis** subsp. nov. Planta 1·5–6 dm. alta ; folia caudicalia 6–9 cm. longa 2–3 cm. lata hispidulosa ; involucra hispidulosa vel glandulosa vel glabrescentia 10–12 mm. longa 5–8 mm. lata, squamis exterioribus 10–13 carinatis ad basim incrassatis pallidis scariosis, interioribus 12–14 carinatis ad basim spongioso-incrassatis ventrale glabris ; corolla 8–9 mm. longa, ligula 1 mm. lata, tubo 3 mm. longo papilloso ; antherae 2·5 mm. longae ; achaenia 5–6 mm. longa 0·6–0·8 mm. lata castanea 10–12-costata ; pappus flavescens 5–6 mm. longus 2-seriatus.

Plant 1·5–6 dm. high ; caudical leaves 6–9 cm. long, 2–3 cm. wide, densely hispidulous with yellowish setules ; involucres 10–12 mm. long, 5–8 mm. wide, like the peduncles hispidulous or glabrescent or sometimes gland-pubescent ; outer involucral bracts 10–13, carinate, becoming scarious at the base ; inner bracts 12–14, dark brown, carinate,

spongy-thickened at the base, glabrous on inner face ; corolla in marginal florets 9 mm. long ; ligule 1 mm. wide ; teeth 0·1–0·3 mm. long ; corolla tube 3 mm. long, papillose, the papillae minute ; anther-tube 2·5 × 0·7 mm. when slit and opened out ; appendages 0·4 mm. long, acuminate ; filaments 0·3 mm. longer ; style branches 1·5 mm. long, 0·1 mm. wide, yellow ; achenes dark brown (reddish brown when immature), 5–6 mm. long, 0·6–0·8 mm. wide, strongly attenuate near the apex, 10-12 ribbed, the ribs unequal, rounded, extending to the pappus disk ; pappus yellowish white, 5–6 mm. long, 2-seriate. Flowering Jan.–Feb. ; flowers lemon yellow. (Fig. 1).

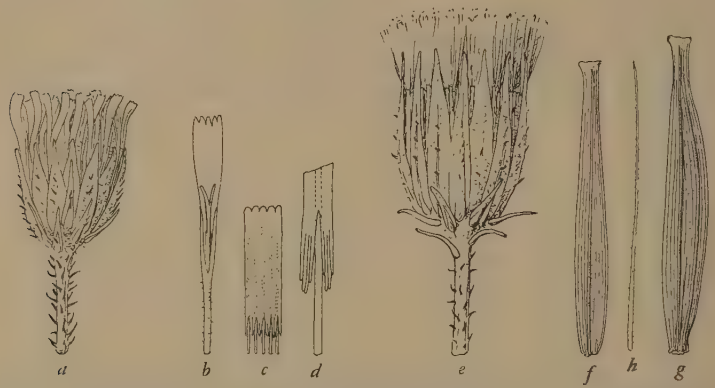

Fig. 1. *Crepis newii* Oliv. et Hiern subsp. *mbuluensis* Babc. from type. *a*, head in anthesis, × 2 ; *b*, floret lacking ovary, × 4 ; *c*, anther tube opened out, × 8 ; *d*, detail of appendages, × 32, ; *e*, fruiting head, × 2 ; *f*, *g*, *h*, two achenes and a pappus bristle, × 8.

Tanganyika Territory : Northern Prov., southern Mbulu distr., western slopes of Mt. Hanang, Shepeda to Gendabi, 2283 m. *Greenway 7676* (K) type, February 10, 1946, flowers and fruits. " Common but scattered with *Vernonia smithiana*, *Senecio bupleuroides*, *Scabiosa columbaria* and *Pterocephalus frutescens* in *Setaria*, *Exotheca abyssinica*, *Themeda triandra* upland grassland on a dark brown loam of volcanic origin on the foot-slopes of the mountain ".

Close to both subsp. *typica* and subsp. *greenwayi*, but distinct from both in the wider outer involucral bracts, the chestnut-brown mature achenes, and, most strikingly, in the smaller florets, with corolla only 9 mm. long in the marginal ones and anther tube only 2·5 mm. long with very short appendages and filaments.

Consideration was given to the possibility that the four or five plants in the type collection represent a hybrid population derived from the crossing of subsp. *typica* with subsp. *greenwayi*, both of which occur in this region. But the smaller florets and wider outer bracts than in either putative parent are constant in all of the plants in the type collection (only one of these plants has mature achenes). In a recently produced hybrid swarm one would expect to find some plants at least with florets and bracts intermediate in size between those of the putative parents instead of constantly smaller in one character and larger in another. Finally, the pollen of three of these plants was compared with pollen of

two plants of subsp. *greenwayii* (*Greenway 7575*, cited above) and in all five plants the grains were abundant and regular in size, averaging about 28 microns in diameter, which indicates that they are sexual diploids. Therefore a new subspecies is recognized. It is possible, however, that this subspecies originated through hybridization between the other two subspecies, followed by transgressive variation and eventually by chance fixation of the peculiar combination of characters found in this new subspecies.

C. newii Oliv. et Hiern, subsp. *nyasensis* Babc. One collection, *Greenway* and *Brenan 8274* (UC, EA) Tanganyika Territory : Iringa Prov., Rungwe distr., Kiwira River, upper fishing camp, 2196 m., is the second record for this subspecies. Both known localities are in the region north of Lake Nyasa. " A carrot-rooted perennial herb with scapes of lemon yellow flowers up to 20 inches tall. Common but very scattered in burnt grassland with *Gerbera*, *Moraea* and *Helichrysum* species on rounded hill slopes on a dark grey loam of volcanic origin " (collector's notes).

C. rueppellii Sch. Bip. Fifteen collections from Uganda and northern Tanganyika provide material establishing such a degree of intergradation between *C. rueppellii* and *C. ugandensis* as to necessitate the merging of the latter with the former. Nevertheless typical *C. rueppellii* presumably still maintains itself in the northern part of its range, whereas typical *C. ugandensis* has recently been collected in Uganda. Apparently we are dealing here with the results of natural crossing between two distinct species which may not be as distantly related as their classification in sections 8 and 27 (1947 *b*) would indicate. The pollen of four of the intergrading variants was found to be abundant, mostly regular, 3-pored and about 28 microns in diameter, thus resembling the pollen of the isotype of *C. ugandensis*. In another variant, however, the pollen was irregular in size and two giant 4-pored grains were observed. Furthermore, the occurrence, at or near the type locality of *C. ugandensis*, of variants that strongly resemble *C. rueppellii* favours the hybridization hypothesis rather than the possible existence of some sort of cline connecting the two extremes. The likelihood that some such situation exists was forecast by the recognition of " The Uganda Assemblage " in the discussion of minor variants under *C. rueppellii* (1947 *b*, 897). Under these circumstances the most practicable procedure is to recognize two subspecies, *typica* and *ugandensis*, with the clear understanding that some of the inter-grading variants must be arbitrarily placed in one or other subspecies.

Key to the Subspecies of C. rueppellii

Plant 0·5–4 dm. high ; basal leaves 3–18 cm. long, mostly obtuse and denticulate ; stems semi-decumbent with flexuous branches ; involucre 8–11 mm. long ; achenes tawny, finely ribbed and finely beaked, the beak paler . . . . . subsp. *typica*

Plant 5–12 dm. high ; basal leaves up to 27 cm. long, mostly acute and dentate ; stems erect with strict branches ; involucre 7–8 mm. long ; achenes brown, less finely ribbed, shortly and coarsely beaked, the beak brown . . . . . subsp. *ugandensis*

C. rueppellii typica subsp. nov. Planta 0·5–4 dm. alta ; folia caudicalia obtusa denticulata ; caules semidecumbentes vel flexuosi ; involucrum 8–11 dm. longum, squamis interioribus 8 in fructu carinatis et spongioso-incrassatis ; corolla 10–13 mm. longa ; achaenia fuscidula rostrata, rostro pallido ; pappus 2-seriatus deciduus.

Plant 0·5–4 dm. high ; root cylindrical, very strongly woody ; caudical leaves 3–18 cm. long, oblanceolate, mostly obtuse, denticulate or sometimes dentate ; stems semidecumbent or flexuous ; involucre 8–11 mm. long ; inner involucral bracts 8, becoming carinate and spongy-thickened at base ; corolla 10–13 mm. long ; corolla tube 3–4 mm. long ; anther tube (3·5) 4·5 mm. long, the filaments very short ; style branches 1·75–2·25 mm. long ; achenes tawny or stramineous, 5–6·5 mm. long, attenuate into a definite, rather fine, pale beak ; pappus white, 4·5–6 mm. long, 2-seriate, fine, soft, deciduous.

N. E. Africa in Eritrea, Abyssinia, British Somaliland, Kenya, Tanganyika, Uganda and western Sudan.

In addition to specimens cited perviously (1947 *b*, 894), the following have been seen by me :

British Somaliland : Surud (Serud) Mts., Shimba Beris, under bushes, 2060 m., *Collenette 393* (K). Tanganyika : Northern Prov., Mbulu distr., slopes of Quasu Mt., near Mbulu, in *Themeda* veld, *Rensberg 146* (EA). Uganda : Toro, Ft. Portal, roadside, *Hazel 216* (K) ; Toro, Nyakasura, volcanic hillside, 1678 m., *Kajamba and Nbatia 3* (K) ; Toro, Kichuamba, grassland, *Hazel 271* (K) ; Moroto Mt., Karamoja, rocky grassland, 2375 m., *Th. 2158* (K).

C. rueppellii ugandensis subsp. nov. Planta 5–12 dm. alta ; folia caudicalia acuta dentata ; caules strictis ; involucrum 7–8 mm. longum, squamis interioribus 8–10 necnon in fructu carinatis et spongioso-incrassatis ; corolla 10–11 mm. longa ; achaenia fusca breve rostrata, rostro fusco ; pappus 3-seriatus persistens.

Plant 5–12 dm. high ; root tapering, fleshy ; caudical leaves up to 27 cm. long, oblanceolate, mostly acute, dentate or sometimes denticulate ; stems and branches strictly erect ; involucre 7–8 mm. long, not much changed in fruit ; corolla 10–11 mm. long ; anther tube 4 mm. long, the filaments 0·75 mm. longer than the appendages ; style branches 2·75 mm. long ; achenes brown 5·5–6 mm. long, gradually attenuate into a coarse ribbed beak about 1 mm. long ; pappus yellowish white, 5–6 mm. long, 3-seriate, persistent.

Throughout Uganda and in the Imatong Mts., Sudan.

Uganda : Toro, Ft. Portal, short grassland, 1666 m., *Snowden 86* (K, UC) type, isotype ; Toro, Nyakasura, top of hill near crater, *Hancock 121* (K) ; W. Suk, Kapenguria, grassy hillside, granitic soil, 2135 m., *Napier 1936* (K, EA) ; Mt. Debasien, 2745 m., *Eggeling 2745* (K) ; Arua, West Nile, *Wallace 1499* (K) ; Budadiri, 1340 m., *Chandler 513* (K) ; Uganda, Imatong Mts., Langra, grassland, 2835 m., *Purseglove 1426* (K) ; Uganda, Imatongs, grassland, 2375 m., *Eggeling 3553* (K) ; Sudan (?) Imatong Mts., Mongalla, *Johnson 1470* (K) ; Kenya Colony : Soy, *Brodhurst-Hill 418* (K, EA).

C. scaposa R. E. Fr. subsp. *typica* Babc. One collection, *Purseglove 2113* (EA) Uganda : Western Prov. : Kigezi, short grassland, 2283 m. ; extends the known distribution of this subspecies 600–700 kilometers westward from the Kenya–Kilimanjaro region.

C. scaposa R. E. Fr. sub. *eximia* Babc. One collection, *Purseglove 2314* (K, EA) Uganda : Western Prov., Kigezi, short grassland, 1830 m., extends the known distribution of this subspecies 600–700 kilometers westward from the Kenya–Kilimanjaro region.

C. scaposa R. E. Fr. subsp. *afromontana* (R. E. Fr.) Babc. One collection, *Chandler 2233* (K) Kenya : Mt. Aberdare, Kinangop, short grass above river, 2675–2700 m., connects the higher montane variant no. 3 (1947 *b*, 381) with the typical form. One of these nine plants has glabrous involucres but it is 2 dm. high with very narrow leaves and the inner involucral bracts are dark green.

C. scaposa R. E. Fr. subsp. *taraxaciformis* (R. E. Fr.) Babc. One plant, *Rogers 421* (K) Tanganyika Terr. : Mt. Kilimanjaro, north slope, Kimengalia stream above Rongri, dry slope among broken lava, 3050 m., is the first collection of this subspecies from Kilimanjaro. The plant is small and resembles minor variant no. 4 (1947 *b*, 383).

Two collections, *Lebrun 8792, 9335* (K) Belgian Congo : Niragongo region, Shaheru Crater Nov. 1937 and Jan. 1938, resemble minor variant no. 5 (1947 *b*, 383) which was collected in the great extinct south crater of Niragongo Volcano.

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North American Orchids*—Until now the orchid enthusiast visiting the North American continent, or the student interested in the orchids of that region, has had to depend for his information on the various standard American Floras, written usually by botanists with no special knowledge of the group. With the appearance of Dr. Correll's book this unsatisfactory position has been remedied ; we have now a book on North American orchids by a recognised specialist in the family.

Dr. Correll is a distinguished member of the group of orchidologists which the late Professor Oakes Ames gathered around him at Harvard University. He collaborated with Professor Ames in a number of scientific papers, and the present work may fairly be taken as expressing

*Native Orchids of North America, north of Mexico. By D. S. Correll. Chronica Botanica Co., Waltham, Mass., U.S.A., and Wm. Dawson and Co. Ltd., London. 1950. Pp. xv, 399, 146 text figures. $7.50.

in general terms not only Dr. Correll's, but also Professor Ames', views on North American orchids. This is well exemplified by the conservative attitude towards genera and species adopted by Dr. Correll, which is in marked contrast with most of the recent treatises on European orchids. The reviewer is not prepared to say that either attitude is correct ; it is sufficient to point out that diversity in treatment makes for the repeated reconsideration of the basis of our taxonomic ideas, and in the long run is undoubtedly beneficial, though it may cause some confusion in the interim.

The book is arranged in the formal style of a Flora, with excellent and clearly arranged keys to both genera and species, reasonably complete bibliographical citations and synonymy, and admirable descriptions. A summarised account of the geographical range of each species in North America is also given. The formal part is completed by a series of nearly 150 delightful line drawings of practically all the species, mostly by Mrs. Blanche Ames and Mr. G. W. Dillon. Apart from the really artistic portrayal of the species, there are numerous clearly drawn dissections showing the floral details. The only criticism which may be made is that no indication is given as to the origin of the individuals figured, an unfortunate omission in a book of this type.

In addition to the more formal portions Dr. Correll provides notes and comments dealing with the taxonomy of and variation in the individual species, ecology, pollination, mycorhiza and other biological subjects, as well as reminiscences of searches for some special species. All these are written in a pleasant and very readable style and greatly enhance the value of the book. Professor E. T. Wherry and Mr. J. V. Watkins contribute notes on the culture of most of the species, a feature not usually found in a systematic account.

The general format is excellent, while a glossary of technical terms used, a selected bibliography of publications on American orchids, and complete indexes of scientific and common names respectively all make the book easy to use. We must indeed congratulate Dr. Correll on the production of an outstanding book, which will long remain as an example of how such a book should be written.

V. S. Summerhayes.

NOTES ON CYPERACEAE, XXVII.*

E. Nelmes.

Mapania in Africa, I : New Liberian Species.

In a recent study of Liberian *Cyperaceae*, collected mainly by Dr. J. T. Baldwin, Jr., it was found that the genus *Mapania*, in Africa, was in need of clarification.

This is not a general account of the genus in Africa, but concerned with the technical description of the new species contained in Dr. Baldwin's collection. Important aspects of a more comprehensive study of African *Mapania*, therefore, such as its apparently primitive position in the *Cyperaceae* ; a comparison of the American, African and Malaysian species ; and the implications of the clear-cut division of the African species into those with large foliaceous bracts and those with small glumiform ones, must await discussion in later contributions to "Mapania in Africa". Furthermore, in order to avoid any overlapping of the general account of the Baldwin collection which is being published elsewhere, and because the preparation of a descriptive account of the African species is not yet complete, this preliminary paper is restricted to the species described.

Mapania coriandrum *Nelmes*, sp. nov. ; affinis *M. oblongae* C. B. Clarke, sed culmis multo majoribus, foliis multo longioribus haud septato-nodulosis basi pseudo-petiolatis, capitulis multo majoribus praecipue differt.

Rhizoma breve, validum, lignosum. *Culmus* erectus, compresso-trigonis, angulis acutus, circiter 50 cm. altus, 3–4 mm. crassus, apicem versus usque 1 cm. crassus, laevis, sulcatus. *Folia* basilaria et subbasilaria, late linearia, parte petiolata inclusa usque circiter 100 cm. longa, circiter 3–4 cm. lata, sicca plana vel planiuscula, haud septato-nodulosa, supra viridia, infra brunnea, nervosa, basi in pseudo-petiolum conduplicatum 20–30 cm. longum 1·5–2 cm. latum (explanatum) sensim attenuata. *Inflorescentia* e spiculis numerosissimis composita, in caput densissimum bracteatum depresso-globosum 4·5 cm. latum 3 cm. longum aggregata. *Bracteae* 2 vel 3, valde inaequilongae, infima foliacea, circiter 25 cm. longa, 2·5 cm. lata, basi 3 cm. lata dilatata, superiores vix foliaceae, circiter 3 cm. longae et latae. *Spicae* in massam densissimam inextricabiliter aggregatae, singulae haud distinguendae. *Achaenium* globosum, 2 mm. diametro, atro-brunneum, nitidum, dense alveolatum, lineis valde prominentibus (carinatis) longitudinalibus furcatis ramosisque obsitum. *Stylus* circiter 4–7 mm. longus, tenuis. *Stigmata* 2.

Liberia : Western Province ; Boporo District, Medina to Bambuna, 31 Oct. 1926, *Linder* 1306 (typus, Herb. Kew.) !

The spikelets with their constituent glumes and squamellae have not been described because this would entail serious damage to the only inflorescence (infrutescence) so far known. It is hoped that more material will be available before the revision of the whole group is completed.

*Continued from K.B. 1951,

Mapania macrantha (*Boeck.*) *Pfeiff.* var. **minor** *Nelmes*, var. nov. ; a typo foliis angustioribus, capitulis minoribus, spicis minoribus, achaeniis tuberculatis nec rugulosis differt.

Culmus altus, circiter 3 mm. crassus, apicem versus vix crassior, laevis, sulcatus. *Folia* late linearia, 115–150 cm. longa, parte petiolata inclusa, 2·5–3 cm. lata, sicca plana vel planiuscula, septato-nodulosa, laete viridia, nervosa, basi in pseudo-petiolum conduplicatum 30–35 cm. longum 1–1·8 cm. latum sensim attenuata. *Inflorescentia* e spicis numerosis composita, in caput densissimum bracteatum subglobosum 3·5 cm. latum 3 cm. longum aggregata. *Bracteae* 2, valde inaequilongae, infima foliacea, circiter 40 cm. longa, 2 cm. lata, basi leviter angustata, superiora subfoliacea, circiter 4 cm. longa, 1 cm. lata, apice longe attenuata. *Spicae* inter se manifeste distinctae, 1–1·5 cm. longae, 3–5 mm. latae, lanceolatae, dense spiculatae, stellatim dispositae. *Spicula* e gluma 1 et squamellae 4 (2 + 2) composita. *Gluma* oblonga vel ovato-oblonga, cymbiformis, apice obtusissima vel rotunda, ciliolato-hispidula, 4–5 mm. longa, circiter 2 mm. lata, coriacea, apice fusco-brunnea et furfuraceo-hispidula, ceterum straminea et glabra, nervo mediano haud vel vix excurrente. *Squamellae* 4, per paria decussata dispositae, 2 exteriores (laterales) conduplicatae vel involutae, costa carinata spinulosa, 2 interiores (antero-posticae) planiusculae, angustiores. *Stamina* 2. *Achaenium* obovatum, apice rotundo-truncatum, valde biconvexum, 1·2–1·4 mm. longum, circiter 1 mm. latum, lineis reticulatis elevatis tuberculisque paucis notatum, fuscum, rugis tuberculisque fuscioribus, haud vel vix stipitatum, apice brevissime apiculatum. *Stylus* 3–4 mm. longus, tenuis, basi haud vel vix incrassatus. *Stigmata* 2, reflexa.

Liberia : Eastern Province ; Webo District, Nyaake (Webo), halfway up Pah Mountain, 21 June 1947, *Baldwin* 6074 (typus, Herb. Kew.) !

The two following species are not closely related to other Liberian species of *Mapania*, but they stand quite near to each other. Their most obvious differences are expressed in the following key :

Folia 4·5–8·5 cm. lata, haud disticha . . . . . *baldwinii*

Folia 2·75–3·5 cm. lata, disticha . . . . . *linderi*

Mapania baldwinii *Nelmes*, sp. nov.

M. comoensis A. Chev. [ex Hutch. in Hutch. et Dalz. Fl. W. Trop. Afr. 2 : 471 : 1936, descr. angl.].

Rhizoma validum, lignosum, haud horizontaliter elongatum. *Culmi* singuli vel bini, e foliorum axillis orti, debiles, erecti vel suberecti, 10–30 cm. longi, inferne 1–2 mm. crassi, superne 1–3 mm. crassi, plerumque sursum incrassati, compresso-trigoni, laeves, tenuiter sulcati, basi vaginis membranaceis brunneis paucis obtecti. *Folia* haud disticha, late linearia, 45–80 cm. longa, 4·5–8·5 cm. lata, sicca plana, papyracea vel coriacea, valde septato-nodulosa, supra laete viridia, nervosa, superne interdum acuminata, apice acuta vel subobtusa, basi in pseudo-petiolum conduplicatum (superne) vel planiusculum (inferne) 10–28 cm. longum 4–10 mm. latum (superne) 1–4·5 mm. latum (inferne) subsensim vel subabrupte contracta. *Inflorescentia* e spicis numerosis composita, in

caput densum bracteatum saepe subglobosum 1·3–2·5 cm. latum 1–2 cm. longum aggregata. *Bracteae* circiter 4–8, ovatae vel lanceolatae, subaequales, haud foliaceae sed glumiformes, nervosae, coriaceae, ferrugineae, marginibus membranaceae, subinvolucratae, duas partes capitis aequantes vel ei aequilongae. *Spicae* inter se haud manifeste distinctae, spiculis numerosis sistentes. *Spicula* e gulma 1 et squamellae 4 (2 + 2) composita. *Gluma* oblonga, apice subrotunda, plana vel planiuscula, 5–6 mm. longa, 1–1·75 mm. lata, translucens, pallide brunnea sed apice fusco-rubido-brunnea, parte superiore minute furfuraceo-hispidula excepta glabra, apice ciliato-hispidula. *Squamellae* 4·5–5 mm. longae, 2 laterales superne conduplicatae, inferne latiores cymbiformes, dorso carinatae carina superne glabra vel sparse hispidula, 2 interiores (antero-posticae) angustae, planiusculae. *Stamina* 2. *Achaenium* obovatum vel suborbiculatum vel interdum subglobosum valde biconvexum, circiter 1–1·5 mm. longum, 1–1·4 mm. latum, tuberculis interdum ope linearum elevatarum connexis dense obsitum, brunnescens, apice rotundatum vel truncato-rotundatum, vix rostratum, basi longe stipitatum. *Stylus* 3–5 mm. longus, tenuis. *Stigmata* 2, vix incrassata.

Ivory Coast : Bas Comoé ; Malamalasso, dans la forêt epaisse, 7–9 mars 1907, *Chevalier* 17498 (Herb. Paris. ; Herb. Kew.) !

Liberia : Central Province ; Sanokwele District, Bilimu (Bobei) Mountain, 24 Dec. 1943, *Harley* 1308 ! Sinoe Co., Duo, common throughout region, 11 March 1948, *Baldwin* 11341 (typus, Herb. Kew.) ! Eastern Province ; Tchien District, Monroviatown, 10 Aug. 1947, *Baldwin* 7097 !

The opportunity afforded by the need for giving a Latin description to validate this species has been taken to choose a less ambiguous epithet than 'comoensis' which instinctively suggests the well-known lake in northern Italy.

Mapania linderi [*Hutch.* in Hutch. & Dalz., Fl. W. Trop. Afr. 2 : 471 : 1936, descr. angl.] *ex Nelmes*, sp. nov.

Rhizoma validum lignosum, haud horizontaliter elongatum. *Culmi* singuli, e foliorum axillis orti, debiles, erecti vel flexuosi, 10–30 cm. longi, inferne 0·75–1 mm. crassi, suprene 1·5–2 mm. crassi, apicem versus usque ad 3 mm. incrassati, compressi vel compresso-trigoni, laeves, tenuiter sulcati, basi vaginis membranaceis brunneis paucis obtecti. *Folia* disticha, late linearia, 70–130 cm. longa, 2·75–3·5 cm. lata, sicca plana, papyracea vel coriacea, valde septato-nodulosa, fusco-viridia, nervosa, apicem versus abrupte acuminata, basi in pseudo-petiolum conduplicatum 15–30 cm. longum 1·5–2·5 cm. latum (explanatum) basin versus paullo latius sensim attenuata. *Inflorescentia* e spicis numerosis composita, in capitulum densum bracteatum subglobosum 1·5–2 cm. latum 1·3–1·8 cm. longum aggregata. *Bracteae* 4–6, ovatae vel lanceolatae, subaequales, haud foliaceae sed glumiformes, nervosae, coriaceae, ferrugineae, marginibus membranaceae, subinvolucratae, duas partes capituli attingentes vel ei aequilongae. *Spicae* inter se haud manifeste distinctae, e spicis numerosis compositae. *Spicula* e gluma 1 et squamellae 4 (2 + 2) composita. *Gluma* oblonga, apice subrotunda, plana vel planiuscula, 6–7 mm. longa, 0·8–1·4 mm. lata, translucens, pallide

brunnea, marginibus tenuiter albo-hyalina, parte superiore minute furfuraceo-hispidula excepta glabra, apice leviter ciliato-hispidula. *Squamellae* 6–8 mm. longae, 2 laterales conduplicatae, dorso carinatae, carina superne hispida, 2 interiores (antero-posticae) angustissimae, planae vel planiusculae. *Stamina* 2. *Achaenium* obovatum, valde biconvexum, 1·5–1·75 mm. longum, circiter 1 mm. latum, lineis tuberculisque elevatis obsitum, demum fuscum, vix stipitatum vel rostratum. *Stylus* 4·5–6 mm. longus, tenuis. *Stigmata* 2, reflexa, haud incrassata.

Liberia : Montserrado Co. ; Du River, Firestone Plantation No. 3, July 1926, *Linder* 114 ; near Lenga (Lengo) Town, Aug. 1926, *Linder* 351. Western Province ; Vonjama District, Wohmen, in virgin forest, 30 Oct. 1947, *Baldwin* 10072 ! Central Province ; Gbarnga District, Gbarnga, 12 Sept. 1926, *Linder* 586 (typus, Herb. Kew.) ! Sanokwele District ; Ganta, 26 July 1939, *Harley* 1233 ! Eastern Province ; Tchien District, Monroviatown, 10 Aug. 1947, *Baldwin* 8018 ! ; Webo District, Dieble, 2 July 1947, *Baldwin* 6396 !

A NEW ELEOCHARIS FROM LIBERIA.

E. Nelmes.

The species of *Eleocharis* described below is remarkable for its numerous extremely slender sterile stems, the relatively few spike-bearing stems being appreciably stouter and firmer. Apart from its nearest relative, *E. trilophus* C. B. Clarke, I cannot recall another species of this genus which possesses such delicate stems.

Eleocharis subtilissima *Nelmes*, sp. nov., ab *E. trilopho* C. B. Clarke spiculis longioribus, glumis oblongo-lanceolatis longioribus, achaeniis cancellatis apice haud constrictis, stylo basi pyramidali, angulos secus angulos achaenii decurrentibus distincta.

Caespitosa. *Culmi* steriles capillares, superne circinnati, numerosi, culmis fertilibus longiores, culmi fertiles 3–6 cm. longi, subfiliformes, erecti vel suberecti, haud flaccidi ; *vaginae* membranaceae, rubidae. *Spiculae* sub-anthesi ellipsoideae vel lanceolato-ellipsoideae, glumae fructiferae oblique divaricatae, 3–5 mm. longae, 2–4-florae. *Glumae* 3–6, oblongo-lanceolatae, apice obtusae vel acutae, 2–2·75 mm. longae, rubidae vel pallidae et rubido-tinctae, marginibus late albo-hyalinae involutae, tenuiter viridi-carinatae. *Achaenia* 2–4, obovoidea, trigona, angulis prominentibus, cancellata, longitudinaliter tenuiter nervosa, viridi-straminea, circiter 1 mm. longa et 0·5 mm. lata, basi acuminata haud constricta. *Stylus* basi valde pyramidalis, in apicem achaenii arcte impositus, angulis secus angulos achaenii leviter decurrentibus. *Setae* 0-plures, brevissimae vel dimidiis achaeniis sublongiores, pallidae.

Liberia ; Monrovia, in masses and mixed with *Utricularia villosula* Stapf, 13 Nov. 1934, *Dinklage* 3272 (typus, Herb. Kew ; Herb. Arn. Arb.) !

GERMINATION OF OLD SEEDS.

Barbara J. Youngman.

The germination of old seeds is a subject that has evoked much interest in various circles during the past hundred years or more. This widespread interest has led to many fantastic claims and much wild speculation as to the longevity of various seeds.

Instances of so-called " mummy " wheat germinating, after having been taken from the tombs of the ancient Egyptians, have appeared in the past. If such statements were correct these seeds would be germinating after a period of storage of over 3,000 years ! Such claims are of course quite unfounded. It would appear that grains of wheat, usually blackened in some way to suggest age, have been sold to tourists by unscrupulous local guides as wheat from the tombs or " mummy wheat ". Such seed, being relatively fresh, often germinates if sown. " Mummy " or " miracle " wheat is in fact *Triticum turgidum* L. var. *mirabile*. a wheat remarkable for its branched panicle and long known in cultivation in certain Mediterranean countries. As a bread wheat it is, however, inferior to varieties now grown. Experiments have shown that wheat seeds may show quite a high percentage germination with up to ten years storage. There are also instances of wheat seed up to 25 years old germinating but this is exceptional. On the whole the seeds of cereals do not retain their vitality for a very long period of time.

Few cultivated plants have seeds that retain their vitality for a long time when buried in the soil, or stored under other conditions.Weed seeds, however, seem to be able to remain viable for a long period of time in the ground. Many instances are known of plants appearing after years of absence from a district, when the ground has been freshly ploughed or disturbed. When old pastures are ploughed up it is often observed that certain weeds appear that have been unknown in that neighbourhood or have not been found there for a number of years. In many instances the seeds of such plants may have lain dormant in the ground and germinated when brought to the surface or exposed to favourable conditions. Although such observations may often give some idea of the time seeds will remain viable in the soil, and are of interest to the agriculturist, they do not give an accurate measure of the longevity of the seeds in question.

The most accurate method of determining longevity is obviously to germinate seeds that have been stored for a known period of time. Where this has been done some very interesting results have been obtained. In 1879 Beal (1) started an experiment to determine the time that certain selected seeds could be stored in the ground and still be capable of germination. He took fifty seeds of each of twenty-two different species of plants. These groups of seeds he mixed with sand and placed each in a glass bottle. Twenty such sets of bottles in all were prepared. These bottles were buried in the soil at a depth of twenty inches, the bottles being placed upside down so that water did not accumulate in them. At first bottles were taken up at five year intervals and attempts made to germinate some of the seeds of each of the twenty-two different species. Later however this period was extended to ten years to prolong the duration of the experiment. In 1940, out of the twenty different kinds of

seed originally buried only two showed any germination, namely *Oenothera biennis* L. and *Rumex crispus* L. They had thus remained viable for 60 years.

In 1902 Duvel (2) started a similar experiment in which the seeds were buried in earthenware pots instead of bottles. In all 32 sets of seeds of various species were buried at varying depths in the ground up to forty-two inches. The interest of this experiment is that the conditions of storage closely approach those of seeds lying dormant in the soil. The environment of seeds during storage is often of importance in determining their life span and numerous trials have been made using various seeds under different conditions.

Museums and herbaria are a source of old seeds which from time to time have been germinated. Becquerel (3) tested the germination of seeds of known age that had been stored in the Herbarium of the Natural History Museum of Paris for many years. Of those that germinated the following were the oldest.

Astragalus massiliensis Lam.	86 years
Dioclea pauciflora Rusby.	93 years
Leucaena leucocephala L.	99 years
Cassia bicapsularis L.	115 years

Two seeds of *Cassia multijuga* Rich. that were 158 years old were also planted and both germinated. It will be noticed that all these seeds belong to the family *Leguminosae*. In this family seeds are often characterised by hard coats.

In 1932 Turner (4) experimented with seeds collected in the Isle of Wight in 1842 by Dr. Bromfield and also with seeds sent to Kew in 1851 by the firm of Peter Lawson & Co. of Edinburgh. These had all been stored in glass jars (not hermetically sealed) under ordinary musuem conditions. Seeds germinated as follows :—

	Age in years	Per Cent. germination
Anthyllis vulneraria L. ...	90	4
Trifolium striatum L. ...	90	16.1
Trifolium pratense L. ...	81	2·6
Lotus uliginosus Schkuhr.	81	9·6
Melilotus alba Desr. ...	81	1 germinated out of 163
Sarothamnus scoparius (L.) Koch (*Cytisus scoparius* (L.) Link.)	81	4 germinated out of 636
Medicago orbicularis All.	78	22

Other seeds sown failed to germinate.

In the early part of the present year (1951) seed from some of the same samples used by Turner, i.e. those received from Messrs. Peter Lawson & Co. in 1851, were sown, these seeds having therefore become one hundred years old in 1951. The seeds sown were those of red clover (*Trifolium pratense* L.), broom (*Sarothamnus scoparius* (L.) Koch) and *Lotus uliginosus* Schkuhr. There was not sufficient quantity of the other seeds used by

Turner to make a reasonable test. Before sowing half of the seeds were treated for twenty minutes in concentrated sulphuric acid to soften the seed coat, while the others were left untreated. The seeds were sown in February in earthenware pots (6 inch) placed on the staging of a moderately warm greenhouse where the temperature was maintained at about 64 deg. F.

The results obtained were as follows :—

	Treated with sulphuric acid	*Untreated*
Trifolium pratense ...	300 seeds sown, 3 germinated	300 sown, 1 germinated
Lotus uliginosus ...	300 seeds sown, 3 germinated	300 sown, 1 germinated
Sarothamnus scoparius	100 seeds sown, none germinated	100 sown, none germinated

Seeds of two species were thus still capable of some germination after one hundred years storage in a museum, although admittedly the percentage germination was very low. It is interesting to compare these figures with Turner's results. Before doing so, however, it is as well to bear in mind that *all* Turner's seed appears to have been treated with sulphuric acid. With *Trifolium pratense* L. the germination has fallen from 2·6 *per cent.* to ·6 *per cent.* and with *Lotus uliginosus* Schkuhr. from 9·6 *per cent.* to .6 *per cent.* It would seem therefore that the last traces of viability in these old seeds may now be fast disappearing.

Although a hundred years may so far be a record for the longevity of seeds of these two species, other seeds of greater age have been germinated by other workers. Seeds of *Albizzia julibrissin* Durazz., that had been collected in China in 1793 and later stored in a box in the British Museum, were found, after the fire of 1940 due to enemy action, to have germinated (5). These seeds were thus one hundred and forty-seven years old when dampness caused them to start growing. This is yet another instance of seeds of *Leguminosae* retaining their viability for a long period.

Seeds of *Nelumbo nucifera* Gaertn., the Indian lotus, also show an amazing length of life and have been the subject of some interesting trials. Ohga (6) germinated seeds of this plant that had been dug from a lake bed in Manchuria. From the age of the surrounding deposits and the number of years that had elapsed since the lake dried up it was estimated that these seeds must have been at least one hundred and twenty years old, although they may have been buried for up to four hundred years. The age, however, could only be roughly estimated and may be subject to many errors. Lotus seeds are, however, known to be very long-lived. Between 1843 and 1855 Brown germinated twelve out of fourteen seeds from the Sir Hans Sloane collection in the British Museum (see De Candolle, 7). These seeds were then known to be at least one hundred and fifty years old. In 1926 Ohga was unable to get any further seeds to germinate but in 1940 one seed was induced to grow, thus being viable after nearly two hundred and fifty years. (6). This is probably the longest accurate record for viability with any seeds so far. In March this year, however, further seeds of the Indian lotus taken from a deposit in Manchuria germinated in an American park after part of the extremely hard outer

coat had been filed away. These seeds were claimed to be fifty thousand years old according to newspaper reports, a figure again based on the age of surrounding deposits, although in this instance rather a liberal estimation !

A knowledge of the percentage germination of seeds after a number of years is, however, of more economic importance than a figure for the oldest recorded seeds that have germinated. Those concerned with agriculture and horticulture are interested in the maximum length of time certain seeds may be stored and still retain a high germination percentage. In this connection conditions of storage are particularly important. Much interesting work has been done in an attempt to find the optimum conditions for the storage of certain seeds but much still remains to be done. It may be possible to greatly increase the longevity and percentage germination after a period of storage by finding the best conditions for the particular seeds. This is not always easy because optimum conditions vary from one plant to another. Longevity may depend on conditions of the seeds themselves, whether fully ripened, moisture content, etc. Most of those seeds which have been found to have a long life span are characterised by the possession of extremely hard seed coats, e.g. *Leguminosae* and *Nelumbo*. It is presumed that these hard coats prevent the exchange of gases and may also protect the seeds from fungal attack.

Ewart, (8) who was one of the earliest botanists to take an interest in the longevity of seeds, divided plants into three classes on the basis of the life span of their seeds under optimum conditions :—*microbiotic*—where the life span is under three years, *mesobiotic*—between three and fifteen years, and *macrobiotic*—over fifteen years. However we have no final information on optimum conditions for all seeds, and, until such time as we have, these divisions have no definite meaning. Already plants classed by Ewart as microbiotic have been raised to the status of mesobiotic and in the future, no doubt, as conditions more nearly approaching the optimum are found further plants will be moved from one group to another.

The writer is indebted to Mr. G. H. Preston for his interest and assistance in carrying out the germination tests with the 100 year old seeds referred to, and for growing on the young plants. These reached the flowering stage in June and July, and thereby afforded proof that the seeds were correctly named.

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FACTS AND SPECULATIONS ON PHYLOGENY IN THE TRIBE CARICEAE OF THE CYPERACEAE.

E. Nelmes.

I. General Considerations.

In the tribe *Cariceae* of the family *Cyperaceae* an open prophyll subtending the fruit (achene) and a well-developed axis arising from the base of the achene and bearing several male flowers are generally recognised as indicating relative primitiveness, and a closed* prophyll (then called a utricle or perigynium) containing a vestigial axis or rhachilla as expressing a more advanced condition. Satisfying this criterion, the four* genera of the *Cariceae* would be arranged in this order : *Schoenoxiphium*, *Kobresia*, *Uncinia*, *Carex*. This is the order in which Kükenthal places them in his monograph (1). Within each of the genera *Schoenoxiphium* and *Kobresia* there is a somewhat similar gradation from the open prophyll combined with the well-developed axis to that exhibited by the four genera themselves within the tribe. It is this fact which makes the keying out of these genera so difficult, as is well seen in Kükenthal's attempt (1).

Schoenoxiphium, at the southern extremity of its range, in South Africa, sometimes has a more or less open prophyll and a flattened but well-developed axis exceeding the length of the prophyll and bearing several male flowers at its apex. In other southern species and invariably in those at the northern limit of the genus, in East Tropical Africa and in the Mediterranean region, the utricle is closed, with a complanate vestigial axis not or only slightly protruding from the mouth.

In *Kobresia*, which is widely spread in the northern hemisphere but which occurs most frequently on the central Asian mountains and the Himalayas, the 'tertiary' axis is shorter and therefore, with its male flowers in the more primitive species, less conspicuous than in the primitive species of *Schoenoxiphium*. The axis is often terete but sometimes complanate as in the other genus, and there is the same gradation from a completely open to a more or less closed prophyll. In this genus the evolutionary movement seems to have proceeded geographically more or less from east to west, in marked contrast to that of *Schoenoxiphium*, which as we saw above, was from south to north. It may be that *Kobresia* was originally, geographically and phylogenetically, contiguous with *Schoenoxiphium* but was carried northwards and into a higher altitude during the Miocene, when the Himalayas were thrust up. The remarkable plant discovered by Dr. C. C. G. J. van Steenis on a north Sumatran mountain in 1937, which Kükenthal at first thought might be a *Kobresia*, but later described as *Schoenoxiphium kobresioideum*, may shed light on this suggestion when the specimens have been more fully studied from this point of view.

In the extremely homogeneous genus *Uncinia*, a group of the southern hemisphere which very likely originated in the Antarctic, the characters of the prophyll and axis are more advanced and constant. The prophyll is invariably a closed utricle and the axis or rhachilla invariably terete

*Except for a small apical orifice through which the stigmas are exserted.

*The small American genus *Bisboeckelera* (*Hoppia*) is omitted from this discussion.

and conspicuously exserted from the mouth of the utricle, ending in a well developed, strong hook (poorly developed only in *U. kingii* Boott), which is an obvious dispersal organ. The inflorescence is always a single androgynaecious spike and there are 3 stigmas with a corresponding trigonous achene.

Carex, which may have arisen in Malaysia, where one finds the greatest number of broad-leaved and multispicate species (considered by the writer and others to represent primitive types in the genus), carries the evolutionary process a stage further. The whole of its 2500 world-wide species, if much of Kükenthal's subgenus *Primocarex*, comprising 60 species, be excluded, have a completely closed utricle and an invariably absent rhachilla.

There were, of course, other structural changes, besides the closing of the prophyll and the reduction of its associated axis, during the evolution of the *Cariceae*, the most conspicuous of which was a reduction from a multispicate (*Carex*) or plurispicate (*Schoenoxiphium* and *Kobresia*) inflorescence to a single terminal spike, though this extreme reduction has not yet been reached in *Schoenoxiphium* as at present constituted. Incidentally, this reductive process seems to have taken place in the *Cyperaceae* generally. *Cyperus*, *Mariscus*, *Scirpus*, *Rhynchospora*, *Scleria*, and other genera, have their primitive panicled and their reduced capitate or unispicate inflorescences. It may be suggested that the expanded species flourished in warm expansive pre-glacial times, but became shrunken in the harsh conditions brought about by mountain upthrusting and later by the ice-ages.

This evolutionary process which appears to have taken place in *Schoenoxiphium*, *Kobresia*, and *Carex*, as well as in many genera of *Cyperaceae* outside the *Cariceae*, has been conspicuously absent from *Uncinia*. It is true that its species vary in size of inflorescence but, as was mentioned above, this is invariably unispicate, the prophyll a closed utricle, and the ultimate axis always a vestigial rhachilla, protruding from the mouth of the utricle and hooked. *Uncinia* has thus become very specialized with this unique dispersal mechanism. Whatever may have been its origin and antecedents, it would seem reasonable to assume that the hooked rhachilla would not be subject to reduction as were the rhachillas of the other genera of the *Cariceae* under discussion, because this would reduce its chances of survival by taking away its successful organ of dispersal. *Uncinia kingii*, however, is a living witness against this apparently sound argument, for in this species the rhachilla and its hook are considerably weakened. Further, it is agreed by those who have closely studied *Carex microglochin* Wahlenb., which has a rhachilla protruding from its utricle, that this species has evolved from an *Uncinia* such as *U. kingii*, or similar uncinioid plant. These two species occur in the same extreme South American area. Other examples are known—for instance in the *Gramineae*, as my colleague Mr. C. E. Hubbard tells me—where a dispersal mechanism has reached a high pitch of efficiency in a genus, but where the genus has then, in spite of this, failed in the struggle for existence, or through some other cause has degenerated, until it has dwindled to a few widely scattered relict species, sometimes, though genetically changing as in *Uncinia* derivatives, unlike these still retaining the dispersal adaptation, which seems unable to function in a changed or changing environment.

This brings me to the main purpose of this paper, which is the derivation of *Carex microglochin* and the other 59 species of Kükenthal's subgenus *Primocarex*, which he places first of the four subgenera into which he divides the genus *Carex* (1). The conception arose in the writer's mind, and has gradually developed into conviction, that many, perhaps half, of the *Primocarices* are not true *Carices*, but have had an *Uncinia* or other uncinioid origin and have either become modified near their antarctic home in South America or Australasia or have migrated up the American or Malaysian mountain chains and colonised areas in the northern hemisphere. About a quarter or third of the other *Primocarices* are, I believe, true *Carices*, while the remaining quarter may have been derived in about equal numbers from *Kobresia* and *Schoenoxiphium*.

The *Carex* origin of many of the *Primocarices* may be questioned primarily because of the presence inside their utricles of a vestigial rhachilla. This rhachilla-bearing character, vestigial though it be, allied to unispicateness, to the androgynaecious spike, and to the trigonous achene, suggests a closer relationship with *Uncinia*, and even with unispicate species of *Schoenoxiphium* and *Kobresia*, than with *Carex*, which, as we have seen, has no rhachilla in its utricles. It seems obvious, therefore, on these grounds alone, that the rhachilla-bearing *Primocarices* must be taken out of *Carex*. We have seen that evolution in *Schoenoxiphium* and *Kobresia* has led to a reduction in the ultimate axis. It would be strange if development in *Carex* had proceeded in the opposite direction ! It was this view of the relatively primitive nature of the rhachilla which caused Kükenthal to put the subgenus *Primocarex* first in his clasification of *Carex*. Krechetovich (2), on the contrary, considered it to be the most advanced group, but he was mystified by the rhachilla, diffidently suggesting that it might be a reduced penultimate axis, and that its achene-bearing utricle might have developed from the sterile cladoprophyll, which is situated at the base of the lateral spikes in species of the subgenus *Indocarex*, during the final stages in the reduction of these tropical, panicled sedges.

Before attempting to take out the *Schoenoxiphium*, *Kobresia*, and *Uncinia* derivatives from the *Primocarices*, it will be convenient to refer to what seem to be true, reduced *Carices*. First to come to mind are species 7–12*, comprising Sect. 4. *Dioiceae* Tuckerm., and including the European (British) *C. dioica* L. These appear to have a close affinitiy with Sect. *Stellulatae* Kunth, Subgen. *Vignea* (P. Beauv.) Nees, with some species of which they readily hybridize. Their dioecious habit is rare in the genus.

It is not intended in this general part of the thesis to examine in detail all of the 60 species contained in Kükenthal's subgenus *Primocarex*. One may, therefore, add to the above the opinion that species no. 6, *C. ursina* Dew. (forming Sect. 3. *Ursinae* Kükenth.), no. 13, *C. scirpoidea* Michx. (Sect. 5. *Scirpinae* Tuckerm.), no. 14, *C. picta* Steud. (Sect. 6. *Pictae* Kükenth.), no. 24, *C. grallatoria* Maxim. (Sect. 9. *Grallatoriae* Kükenth.), and no. 25, *C. leptalea* Wahlenb. (Sect. 10. *Psilocarpae* Kükenth., Subsect. 1. *Polytrichoideae* Tuckerm.), all monotypic sections (one subsection), appear to be true *Carices*. In addition there are a few other apparent

*These and subsequent numbers are those of the 60 species comprising Kükenthal's subgen. *Primocarex* in his monograph (see reference 1 at end).

Carices mixed in larger sections with what are probably derivatives from other genera. Finally, there is the Asiatic group of species, nos. 46 to 51, which Krechetovich considered to be descended from *Eucarices*, but whose origin remains very doubtful.

It should be noted that these *Primocarices* which, it is here suggested, are in fact of *Carex* descent, are without a rhachilla in their utricles, and this is a very significant fact. Added weight, however, is given to this by the further fact that the species in question possess other caricoid characters besides the absence of a rhacilla, characters through which they may be seen to be related to species or groups of species which are undisputedly true *Carices*.

A few of the rhachilla-bearing *Primocarices* have in recent years been placed by Ivanova (3) in *Kobresia*. These are *C. nardina* Fries and *C. hepburnii* Boott, species 1 and 2, forming part of Sect. 1. *Microcephalae* Th. Holm in Subgen. *Primocarex* Kükenth., which now become *Kobresia arctica* Ivanova and *K. hepburnii* (Boott) Ivanova respectively, and *C. filifolia* Nutt. (*Kobresia globularis* Dewey). This last plant is no. 20 of the *Primocarices*, the first of the four species forming Sect. 8. *Petraeae* O. F. Lang. The other three, which also appear to me to be derived from *Kobresia*, are 21, *C. rupestris* All., 22, *C. argunensis* Turcz., and 23, *C. obtusata* Liljebl.

It should be stressed that all the species contained in Subgenus *Primocarex* have a closed utricle, and that with the exception of *C. microglochin* they all either have a very much reduced wholly-included rhachilla, or the rhachilla is completely absent. Thus, in one or both of these characters, these supposed descendants of *Schoenoxiphium*, *Kobresia*, and *Uncinia* vary in considerable degree from these genera as at present constituted.

Working through *Primocarex* one soon comes to two other species which may be *Kobresia* derivatives, but which do not exhibit clear evidence of their descent. These are those remarkable tropical African sedges, 4, *C. monostachya* A. Rich. (*Uncinia digyna* Hochst.) and 5, *C. runssoroensis* K. Schum., together forming Kükenthal's Sect. 2. *Longespicatae*. These are larger plants with much longer (2·5–5 cm. long) spikes than most of the other *Primocarices*. *C. runssoroensis* is a leafless plant. They somewhat resemble, in facies, such a species as *Kobresia schoenoides* (C. A. Mey.) Steud., but there is a large gap between the open prophyll and elongated ' tertiary ' axis of the latter and the closed utricle and vestigial rhachilla of the former.

There do not appear to be any more *Primocarices* derived from *Kobresia*, which thus constitutes a comparatively small element in the subgenus.

This is probably true also of *Schoenoxiphium*, though the extent of contribution of this genus to the *Primocarices* is not so clear. One of these which seems fairly certain to be a reduced *Schoenoxiphium* is *C. phyllostachys* C. A. Mey., which occurs in the Caucasus region. It has characters in common with *Schoenoxiphium* such as a flexuous and dilated rhachis, and its utricle, with a rhachilla often extending up to the aperture, bears a considerable resemblance to the utricle of this genus. It is no. 31 in Kükenthal's monograph, and with 32, *C. multicaulis* L. H. Bail. and 33,

C. geyeri Boott forms Subsect. 3. *Firmiculmes* Kükenth. of his Sect. 10. *Psilocarpae*. These two Pacific North American plants, though with features very similar to some of those of *C. phyllostachys*, differ in other characters, which suggest uncinioid origin.

The only other *Primocarices* which are possibly degraded members of *Schoenoxiphium* are the five, nos. 26–30, which belong to the same section as the above-mentioned species and comprise Kükenthal's Subsection *Seticulmes*. These form a group in south Brazil, more or less isolated from groups further west, which I think resulted from the northward migration and modification of antarctic uncinioid ancestors. If this group of sedges really are descended from *Schoenoxiphium* they bring further evidence for the Wegener theory of continental drift.

Finally, we come to *Uncinia*, the chief contributor, as here postulated, to the *Primocarices*. This genus, as is suggested above, almost certainly had an Antarctic origin, and is found today mainly in South America, Australasia, and the islands of the southern ocean. During its northern migration, due to widespread lowering of polar temperature, *Uncinia* or uncinioid relatives migrated from the south up the Andes or similar high-lands and up the Malaysian chain, some of them becoming modified *en route*, and successfully colonized large tracts in the cooler parts of the northern hemisphere, or dropped out in groups by the wayside, especially along the Chilean Andes, and in southern Australasia.

In support of this theoretical visualization it will be convenient to take first the last group of the *Primocarices*, Sect. 14. *Unciniiformes*, Subsect. 5. *Pauciflorae*, and see what evidence it can offer at this present stage in its evolution.

The *Pauciflorae* contain species no. 57, *C. microglochin* Wahlenb., and its var. *oligantha* (Boott) Kükenth., 58, *C. lyonii* Boott. (stated by Mackenzie (7) to be a synonym of *C. microglochin*), 59, *C. pauciflora* Lightf., and 60, *C. parva* Nees.

The most interesting member of this group, perhaps the most interesting of all sedges, phylogenetically, is *C. microglochin*.

It was stated earlier in this thesis that *Uncinia* is a very natural genus. Every species but one has the rhachilla strongly developed, well protruding and strongly hooked. The exception is *U. kingii* Boott. This has, it is true, a protruding and hooked rhachilla, but the plant is smaller than most species of *Uncinia*, and its inflorescence (spike) is capitate instead of the invariably cylindric, elongated spike of the other species. The hook also is different. It is smaller and weaker than that of all the other species : it has a general appearance of enfeeblement. One is forced to the conclusion that it represents an intermediate stage between *Uncinia* proper and *Carex microglochin*, which, as I think, strikingly takes a very similar, second step away from the average *Uncinia*. It is a still smaller plant than *Uncinia kingii*, its rhachilla less exserted from the utricle, and the hook completely eliminated. The shape of the spike is similar in this species and *U. kingii* and the utricles of both are " lanceolate-subulate ". The var. *oligantha* (*C. camptoglochin* Krecz.), a more robust plant with longly stipitate, larger and more extremely reflexed utricles, occurs over

a similar area to that of *U. kingii* (with which it agrees in having grooved and red-tipped rhachillas), in extreme South America, but the species itself covers a large area round the arctic-alpine region of the northern hemisphere. In recent years *C. microglochin* and/or its variety have been collected at the northern end of the Andes, in Colombia (and as this is being written the species is reported from Ecuador and Bolivia), thus tending to confirm the theory formed before these discoveries were known, that *C. microglochin* was developed from *Uncinia* in the Antarctic and travelled by way of the Andes or by an earlier more or less continuous land bridge to the northern hemisphere, where it successfully colonised extensive habitats similar to those in the south.

There is little doubt that Kükenthal is right in relating *C. parva* Nees and *C. pauciflora* Lightf. to *C. microglochin*. They both bear a strong likeness to it, being similarly small plants, with very similar utricles, similarly reflexed. In *C. parva* the rhachilla has shrunk into the utricle and in *C. pauciflora* it has entirely disappeared, but because of their otherwise close resemblance both to each other and to *C. microglochin* they form a homogeneous group.

Du Rietz (4) and others have written on the subject of bipolar species, i.e. species which occur both in arctic and antarctic localities, and have come to the conclusion that there has been a migration from north to south, or *vice versa*, by way of the great mountain ranges, the Rockies and the Andes. If one accepts the view that it is a reduced *Uncinia*, the migration of *C. microglochin* has been from south to north and thence east.

Kükenthal (1) divided *Uncinia* into two subgenera, Subgen. *Eu-Uncinia* and Subgen. *Pseudocarex*. The sole occupant of the second subgenus is *U. kingii*. Clarke also, at an earlier date (5), classified *Uncinia* somewhat similarly. He had a group which he also called *Pseudocarex*, with a single species. This is not *U. kingii*, which he placed with the other species of *Uncinia*, but *Carex microglochin*, which he treated as *Uncinia microglochin* Spreng. In discussing this classification, Clarke remarks that if this species had been " found in the southern hemisphere (where *Uncinia* occurs) instead of in the northern, authors would have placed it without hesitation in *Uncinia*," by which he must mean if it had been found *first* in the south, because he records it from its Antarctic localities as well as from its stations in North America, Europe and Asia. It had not then been discovered in northern South America.

After its successful occupation of a large circumpolar area, *C. microglochin* gave rise to *C. pauciflora*, in which still smaller species the rhachilla has disappeared. This species also has been able to spread about the northern regions and is found throughout much the same area as that of *C. microglochin*. *C. parva* is restricted to Asia and though its resemblance to *C. microglochin* is considerable a slight doubt about its origin is discussed later.

Another group of *Primocarices* which seems extremely likely to have been derived from *Uncinia* is that immediately preceding the *Pauciflorae*, i.e. Subsect. 4. *Macrostylae* Kükenth., though its area of distribution does not appear to support this view. It contains species no. 54, *C. pulicaris* L., the British flea sedge, which occurs over a wide area of Europe and Asia

Minor, no. 55, *C. macrostyla* Lapeyr., restricted to the Pyrenees and Arragon, and no. 56, *C. peregrina* Link, from Madeira, the Azores, and west Kenya. In the first-mentioned species sometimes, and in the others more frequently, a much reduced rhachilla is found in the utricle. The stigmas are also reduced to 2 : the number in *Uncinia* is invariably 3. In these species, however, the utricles bear to a remarkable degree a resemblance to the typical *Uncinia* utricle, which in some species is only subtrigonous, a step towards the distigmatic, plano-convex one of *C. pulicaris* and its allies. The utricles in these species, as also in *Uncinia*, are nerveless, with a plumbaginous surface, oblong-ellipsoid in shape, glabrous, sometimes becoming reflexed (strikingly so in *Uncinia compacta* R. Br. of Australasia), gradually narrowing above into a beak with a subtruncate, whitish-hyaline apex, and below to a shrunken-sulcate, pseudostipitate base. (*Carex* often has utricles more or less nervose and with a bifid beak.) The achenes in each group are similar (oblong) in shape and surface, conspicuous but small epidermal cells giving a minutely alveolate (squarish) appearance. The lax-flowered spikes, too, of the *Macrostylae*, resemble those of a number of *Uncinia* species.

Species of *Uncinia* in America extend as far north as the West Indies and it may be that the uncinioid ancestor of *C. peregrina*, the most primitive member of its group, came over to the Madeira–Azores region, the only known area of distribution until comparatively recent years, on an earlier equivalent of the Biscay branch of the Gulf Stream. The utricles of many sedges are well adapted for floating on water. The central American *Uncinia tenuis* Poepp. ex Kunth bears a close likeness to the three *Primocarices* under discussion. Because, however, of the even greater resemblance these bear to the Australasian *U. compacta*, it may be suggested that their direction of migration has been from the south-east. Furthermore, *C. peregrina* was discovered in west Kenya by the Svenska Kenia–Mt. Aberdare Expedition of 1921–22, an extension of range with a significant bearing on the suggested south-eastern origin of this group of sedges. Additional interesting links may yet be found in Malaysia or other intermediate region.

At this point it may be mentioned as a remarkable fact that both *Primocarex* and *Uncinia* are absent from tropical and South Africa, except the two species referred to earlier in this paper, *C. monostachya* and *C. runssoroensis*, which probably came into north-east Africa from Asia, and *C. peregrina*, discussed above.

There are three other groups of *Primocarices* which are here placed in the category of uncinioid derivatives. Two of these are subsections of the Section we have been discussing immediately above, Sect. 14. *Uncinii-formes*. They are Subsect. 1. *Aciculares* Kükenth. and Subsect. 3. *Callistachys* (Heuff.) Aschers. et Graebn., and between these groups Kükenthal has placed the Pacific group of disputed origin, Subsect. 2. *Capitellatae* Meinshaus.

The *Aciculares* are composed of 4 species in Kükenthal's monograph, but he places the Tasmanian *C. archeri* Boott as a synonym of the New Zealand *C. acicularis* Boott. In the writer's opinion these two are specifically distinct. There may even be a third species closely related to those, in Australia. *C. acicularis* is Kükenthal's no. 44. The other three species

in this subsection are no. 42, *C. trichodes* Steud. (including var. *lateriflora* (Phil.) Kükenth.), 43, *C. caduca* Boott, and 45, *C. vallis-pulchrae* Phil., the first and third from the Chilean Andes, the second from Tierra del Fuega, and the last also from Argentina and the Falkland Islands.

C. trichodes and *C. caduca* depart from *Uncinia* in having their stigmas reduced to 2, with corresponding plano-convex utricles and lenticular achenes. There are other reductive characters, i.e. the rhachilla in *C. trichodes* is very short and in *C. caduca* completely eliminated. These two species scarcely progressed north from the Antarctic.

C. acicularis, *C. archeri*, and *C. vallis-pulchrae* have 3 stigmas and trigonous fruits. They seem to need placing in a separate group from the other two species.

It will be noted that these three species span the southern ocean, linking Australasia with South America. Even if *C. vallis-pulchrae* should be excluded from association with the other two, these Australasian species would still have an extremely interesting bearing on the question of the relationship between plants of Tasmania and Antarctic South America, and on the theory of a former land bridge connecting these two areas, put forward by Rodway (6) and others. The inflorescence of the two species bears a striking resemblance to that of *Uncinia kingii* and they would appear to have originated, like *Carex microglochin*, from an ancestor of similar structure to this reduced *Uncinia*. Further, *C. acicularis* and *C. archeri* look much like the Asiatic *C. parva* Nees, which is here left in Subsect. *Pauciflorae* with *C. microglochin* and *C. pauciflora*. If its fruits, when mature, became only patulous instead of strongly reflexed, one would have been strongly tempted to place *C. parva* in Subsect. *Aciculares*, and to have said that its immediate ancestors came up to Asia by way of the Malaysian mountains rather than by the more roundabout route of the Andes chain to northern America and thence to the Himalayas.

Next we come to Subsect. 3. *Callistachys* (Heuff.) Aschers. et Graebn., comprising species 52, *C. pyrenaica* Wahlenb. (including the Australasian *C. cephalotes* F. Muell., which Kükenthal treated as a var. of *C. pyrenaica*) and 53, *C. nigricans* C. A. Mey. *C. pyrenaica* occurs in large areas in the northern hemisphere as well as in New Zealand ; *C. nigricans* is a subarctic and Pacific North American species.

The utricles of these three species show a great resemblance to those of the New Zealand *Uncinia compacta*—long stipe, colour and subsequent extreme spreading. Their rhizomes are similarly elongated and their glumes are of a similar colour. A rhachilla has been found only, and then only sometimes, in *C. pyrenaica*, so that, in this respect at least, the species of this group have advanced further from their uncinioid ancestors than any we have so far discussed.

Sect. 13. *Circinatae* Meinshausen, containing species nos. 37–41, appear to be mostly *Carices* proper, but 38, *C. circinata* C. A. Mey itself, the only one of the five with a rhachilla, appears to me to belong rightly to *Callistachys*, discussed above, and therefore to have had an uncinioid origin.

The final group of the *Primocarices* which are best treated as reduced species of *Uncinia* are Sect. 7. *Junciformes* Boeck., comprising species 15–19,

four of them with and one without a rhachilla. These occur mainly on the Chilean Andes, one being found also in Peru, and one in Patagonia only. In recent years two Argentine species have been described by Barros which seem to me to belong here. These are *C. argentina* and *C. sorianoi*, the latter of which Barros himself places in Sect. 1. *Microcephalae* Th. Holm. The glumes of species 15, *C. aphylla* Kunth and those of 17, *C. setifolia* Kunze apud Kunth are very *Uncinia*-like, such as those of *U. lechleriana* Steud., from extreme South America, with wide, red-brown, membranaceous margins, but the spike of *C. aphylla* is much reduced and ovoid to subglobose. The rhachilla is long, slender, and ciliate in this species and in *C. setifolia*. In species 18 and 19, *C. andina* Phil. and *C. patagonica* Speg. respectively, the rhachilla is short, elliptic, and slightly ciliate.

It should be mentioned that Krechetovich (2) refers to the " certain community of origin of *Aciculares*, *Macrostylae*, and *Callistachys* with *Uncinia* sect. *Stenandrae* C. B. Clarke (the mainly Australasian group). This "origin", in the view of Krechetovich, was ultimately from indocaricoid ancestors, as is made clear in a later reference to *Callistachys* and " certain individual species such as *C. pauciflora* Lightf. or *C. pulicaris* L." The writer is in agreement with the first part of this view that *Uncinia* and much of *Primocarex* have had a common origin, but differs in believing that the common origin of *Uncinia* and *Carex* goes back far beyond the early *Indocarices* of Malaysia which, it is considered, were contemporary with the early *Unciniae* of Antarctica and were not their progenitors.

In this general part of the thesis not every group into which Kükenthal divided his *Primocarices* has been discussed, because a detailed examination is envisaged for a second part, but mention must be made of Sect. 11. *Leucocephalae* Th. Holm. which contains the single species, no. 34, *C. fraseri* Andr. on which Mackenzie (7) has founded his genus *Cymophyllus*. This is a most remarkable plant, confined to the higher Alleghanies, in the south-eastern United States. The wide leaves have neither midrib nor sheath and their margins are finely undulate. The flowering stems arise laterally. There is sometimes a rhachilla inside its white utricles. The glumes also are white.

This plant is undoubtedly much reduced and, in common with other authorities on the sedges, the writer is unable to suggest how and from what kind of plants it may have had its origin.

Only less remarkable are the two occupants of Sect. 12. *Inflatae* Kükenth., 35, *C. breweri* Boott and 36, *C. engelmannii* L. H. Bail. These are quite distinct vegetatively from *C. fraseri*, but resemble it somewhat in their utricles. They occur on summits of high peaks on the Pacific side of North America.

It is probable that a most rich and varied flora perished when Antarctica became heavily glaciated. For ages the plants of the tropics have luxuriated and perhaps remained phylogenetically relatively quiescent, but at the poles numerous periods of lowered temperature rendered their floras highly dynamic, with consequent invasions tropic-wards. How many times these migrations took place we do not know, but one may guess at the varied nature of their plant contents by noting the many and

diverse species which still survive in Australasia, South America, and South Africa.

I am indebted to Dr. W. B. Turrill for kindly reading through this paper and suggesting a number of important modifications, all of which have been adopted.

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WILD AND CULTIVATED OLIVES.

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Wine and olive oil have been, from prehistoric times, characteristic products of the lands bordering the Mediterranean Sea. The cultivation of the grape has spread far beyond the botanical boundaries of the Mediterranean Region, however these have been defined, and into countries with climates different from those of Mediterranean lands. The common olive, however, remains characteristic of the Mediterranean Basin, with relatively insignificant modern extensions of cultivation to the southern and western hemispheres. Earlier phytogeographers tended to limit application of the phrase " Mediterranean Region " to areas with *Pinus halepensis* woods, macchia, and olive cultivation. From the vegetational point of view there is much to be said for this, since olive plantations in Mediterranean countries largely occupy areas that no doubt were formerly covered by evergreen woodlands, and the range of the remaining sclerophyllous climax communities or their relicts coincides very clearly with the realm of the typical Mediterranean climate. Floristically, however, there is much to be said for giving a wider connotation to the " Mediterranean Region " and, perhaps, the compromise of accepting the " Mediterranean Basin " within the wider " Mediterranean Region " best serves phytogeographical needs.

The economic importance of the cultivated olive is probably not fully appreciated in Britain. It is cultivated mainly for its fruits and for the oil expressed from its fruits. In the domestic economy of Mediterranean countries the oil largely replaces butter and other animal fats as these are used in more northern lands. In addition, there is a very considerable export trade from some countries. Commercially, the oil has a very wide use, extending from food production to the making of school-girl complexions. It is an important source of income, especially to peasant proprietors, though there has been some exaggeration in statements regarding fortune making in olive oil. I knew an old lady in Greece whose sole income was said to be the produce of her olive tree. It would be safer to say her sole visible source of income, for she was renowned as a witch and there were probably invisible and non-botanical sources of income unrecorded on tax returns. It is difficult to say how reliable are trade figures for olive products, but between the two world wars the mean of the areas recorded as covered by olive plantations in Mediterranean countries was 22,580 square miles and the annual production was given as about 160,000 tons of oil and 20,000 tons of fruit for table use. Spain, Italy, French North Africa, and Greece were the largest producers, in the order named. The cultivation of the olive has been extended during the past century or two to parts of North America (especially Mexico and the southern United States), South America (especially Chile), South Africa, and Australia.

The common olive, *Olea europaea* L., is an evergreen tree, up to 15 m. in height, or a shrub. Its opposite leaves are typically narrowly elliptic to linear-oblanceolate of a subdued green on the adaxial surface and whitish grey with a thick covering of small scales on the abaxial surface.

The flowers are small and white and are produced in May in usually axillary or rarely terminal inflorescences. The fruit is a drupe, the pericarp, stone, and seed proper containing a fixed oil in different proportions. There are relatively few serious pests and diseases of the olive, and the main limiting factor to its range is frost followed by wet weather. Even so it grows out of doors at Kew but without reproducing itself, though it is said to have produced fruits near Plymouth. The yield of fruit and oil can be greatly increased by planting in well-drained situations on calcareous, schistose, sandy, or even rocky but sunny slopes and by careful after treatment including loosening of the soil around the roots, mulching, application of fertilizers, and judicious pruning. Seeds germinate best after removal of the pericarp. Propagation is extremely easy by making cuttings of various kinds, the use of knobs (" uovoli," Italian for " little eggs ") planted like bulbs, or by grafting. Olives have a very extensive root system and, unlike the vine, plants must be well-spaced up to 10 m. or more in all directions for most varieties.

Varieties. A very large number of variants of the cultivated olive have been recognized and given vernacular names. Several classifications have been proposed but these have mostly been based either on inadequate material and data or on the olives of only one more or less restricted area (e.g. Spain, S. France, or Italy). The basis of classification is always, or nearly always, the general shape and apical characters of the fruit. This is, no doubt, mainly because the economic importance of the olive is primarily its fruit harvest but a subsidiary reason is the great plasticity of its foliage. I have collected in South Macedonia two so-called " varieties "—*typica* and *buxifolia*—on different parts of the same individual tree. There is no doubt that there are a number of varietal characters with a genetic basis. As already mentioned, vegetative propagation is easy and is the usual method of multiplying stock. Hence, as with so many other cultispecies, varieties occur mainly as clones. These, for the olive, still await systematic cytogenetical study.

So far we have referred only to the cultivated olive. In many macchie in Mediterranean countries there occur the so-called wild olives. These are often grouped together under the name " var. *oleaster* ". Usually the plants are shrubs rather than trees, the branches are often spiny, and the fruits are smaller than those of cultivated olives and yield much less oil. To a certain extent the relationship of wild to cultivated olives resembles that of crab apples to the cultivated sorts. Actually the " var. *oleaster* " is a mixture of micro-varieties which often have characters parallel to those of cultivars, except for the smaller size and reduced oil content of the fruits. Some authors state definitely that cultivars can and do revert to " var. *oleaster* " if unattended for a number of years and, conversely, that cultural treatment will turn wild olives into cultivated kinds. Convincing proof of both statements has not been found. Intermediates of various kinds certainly occur and that cultural treatment greatly increases the quality and quantity of fruit produced and also modifies the habit and leaf characters cannot be disputed. The division of *Olea europaea* into var. *sativa*, the cultivated olives, and var. *oleaster*, the wild olives of the Mediterranean Basin, is a classification that may have some use economically and ecologically, but a detailed morphological

examination correlated with cytogenetical studies would almost certainly suggest another and more scientifically convenient systematic grouping.

Cytology. Sax and Abbe (1932) and H. Taylor (1945) give 2n=46 or n=23 as the chromosome number of cultivated plants of *Olea europaea.* A. Anderson (1931) for *O. chrysophylla* records figures of or equivalent to n=20, 22, or 24 for different parts of the flower. The figure n=23 is recorded for a large number of *Oleaceae–Oleoideae* and it has been suggested that it originated by allopolyploidy from basic numbers of n=11 and n=12. There is at present no evidence of polyploidy within the genus *Olea*, that is of secondary polyploidy if 23 be of allopolyploid origin. If many variants of *O. europaea* and other distinct wild species were cytologically examined it is possible that other chromosome numbers would be found.

The genus Olea. Before discussing the interesting problems concerning the origin of the common olive it is necessary to consider other species of *Olea* than *O. europaea.* The genus *Olea* requires monographing since all general accounts are now hopelessly out-of-date. About 85 species of *Olea* have been recognized in herbaria but comparative researches may well reduce this number considerably. The genus is mainly tropical and, apart from *O. europaea*, ranges through Tropical and South Africa, the Mascarenes, Western China, the Indian subcontinent, Malaya, and Australasia. It does not occur as a native in the New World. The species of greatest interest in connection with the history of the common olive is *O. chrysophylla* Lam. and microspecies or varieties of this. *O. chrysophylla* Lam. was originally described from Mauritius. It is now known to range widely on the African continent and specimens have been examined from Eritraea, Sudan, Somaliland, Abyssinia, Kenya, Tanganyika, Uganda, the Belgian Congo, and North and South Rhodesia, as well as from Zanzibar, Mauritius, Réunion, and Tropical Arabia. Its farthest north-eastern known occurrence is on Gebel (or Jebel) Elba near the Egyptian and Sudanese boundary. It differs, in typical specimens, from *O. europaea* in the dark glossy adaxial and the ferruginous or golden to reddish abaxial surface of the leaves. The fruits too are smaller than those of cultivated olives and generally even smaller than those of " wild olives " of the Mediterranean Basin. Most often, if the specimens be properly collected and preserved, there is no difficulty in distinguishing *O. europaea* and *O. chrysophylla*, apart from range differences. There are, however, a number of plants that have been described as distinct species that require further consideration. *O. somaliensis* Baker, from Somaliland, is considered to be no more than a slight variant of typical *O. chrysophylla.* Only one sheet (a barren specimen) of *O. laperrini* has been seen from the Hoggar Mountains of the central Sahara. It is, in leaf characters, very close to *O. europaea* L. var. *maderensis* Lowe from Madeira, and, following the example of Chevalier, the two may well be united as one taxon. This appears to be best considered as a variety of *O. europaea* verging in the apparently darker green of the adaxial surface of the leaves towards *O. chrysophylla.* *O. verrucosa* Link, from South Africa, appears to be at most a geographical variety or microspecies of *O. chrysophylla* with the leaves narrower in relation to their length than in most tropical African material of *O. chrysophylla.* Lastly, we turn to the extra-African *O. ferruginea* Royle (*O. cuspidata* Wall.) from the western Hima-

laya, Afghanistan, Baluchistan, and western China. This, again, scarcely differs from *O. chrysophylla*, except that, on the average, the leaves are somewhat narrower relative to their length than are those of specimens of *O. chrysophylla* from Tropical Africa.

This briefly summarized survey thus leads to the conclusion that the aggregate wild species *O. chrysophylla* has a range throughout much of Central and East Tropical Africa, South Africa, Baluchistan, Afghanistan, the western Himalaya, and western China. The nearest approach of its range to that of *O. europaea* is in northern Tropical Africa where it occurs in various parts of the Sudan with typically developed characters. In the Hoggar mountains in the southern Sahara is found the olive that was named *O. laperrini*. It must be remembered that in northern Tropical Africa localities in which wild olives grow are often isolated one from another by country with habitat conditions now quite unsuitable for any olives. The olives from Gebel Marra are particularly interesting. They have been named *O. chrysophylla* by some botanists and *O. laperrini* by Chevalier (1948). In the writer's opinion they are intermediate in characters between *O. europaea* and *O. chrysophylla* and may best be classified as *O. europaea* var. *laperrini* or, if this be taxonomically united with the narrow leaved plants from Madeira, as *O. europaea* var. *maderensis*. *O. chrysophylla*, like *O. europaea*, shows a high degree of variation in leaf shape, especially the variation that indicates high plasticity of expression of one genotype. So-called " *buxifolia* " variants occur in both species.

Suggested origin of the cultivated olive.

It is very doubtful if *Olea europaea* be of European origin in spite of its specific epithet. The evidence regarding its origin is, however, circumstantial though we can now focus more clearly on the needs for further research. That the olive has been cultivated in the Mediterranean Basin from the days of early civilization is certain. There are numerous references to the olive, and its oil, and its wood, in the Old Testament. In the introductory remarks it was noted that the olive and the vine were characteristic cultivated plants of Mediterranean countries. In the book of Genesis we are informed that Noah was acquainted with both. The dove brought back an olive leaf to the ark and in due course Noah " planted a vineyard : and he drank of the wine, and was drunken."

In Greek mythology, the legends point to the introduction of the cultivated olive into Greece from an outside source. The myths vary in detail but that centering round Pallas Athene and the foundation of Athens is best known. Pausanias tells us that the goddess, as token a of her power, produced the olive tree at the time of her contest with Poseidon. It is further of interest to recall that many of the myths and legends of the olive illustrate the importance of vegetative propagation. Thus, according to another Greek tradition the first olive branch that reached the country was carried by a dove from Phoenicia to the temple of Zeus in Epirus. Archaeological evidence confirms the importance of olive oil from Early Minoan times onwards.

In Egypt at the present day the olive (*O. europaea*) is said to be cultivated everywhere but rarely to be subspontaneous. That it and its products were known to the ancient Egyptians even in pre-dynastic times

seems certain. The evidence has been summarized by the late Prof. Newberry and on this point appears to be conclusive. Whether or not the facts more than suggest the possibility of climatic changes of such a kind as to have greatly reduced the cultivation of the olive in north-east Africa has been debated.

In considering the botanical origin of the cultivated olive we have meagre direct evidence. Fossils named *Olea* have been recorded from Tertiary beds in Europe and America. None of the records traced is convincing and very possibly the specimens on which they are based all represent other genera. The few published chromosome counts throw no light on the problem and no relevant genetical studies have been made so far as is known.

First, some consideration should be given to the possible origin of the cultivated olive from the " oleaster." The " wild olives " classified as *Olea europaea* var. *oleaster* vary greatly and in many characters parallel to variations of cultivated olives. There is clear field evidence that at least some of them have originated from cultivated trees by the cultivation of these having ceased, or by suckers or seeds from these. While complete proof is still to seek there seems no botanical reason why all " oleaster " plants should not have arisen from cultivated plants. This would explain why it is sometimes recorded as possible to bring " oleasters " into paying cultivation since it would be merely bringing them back into a state of cultivated grace. If the cultivated olive originated from originally wild var. *oleaster*, then to account for the parallel variations one would have to assume either numerous origins, of which there is no evidence, or a large series of parallel mutations.

A second possibility is that *Olea chrysophylla* is the ancestor of the cultivated olive. In favour of this are the occurrence of olives with some characters more or less intermediate between the two species as at present accepted and recent discoveries in northern Tropical Africa that link up their geographical ranges. The archaeological evidence set forth by Prof. Newberry suggests that Egypt or the Sudan rather than Asia Minor, Palestine, or Syria may well have been the original centre of dispersal of the cultivated olive. From Egypt it could have reached Europe, and in particular Greece, either through Crete or through Palestine, Syria, and Asia Minor.

A third possibility is that *O. laperrini* represents the immediate ancestral stock and that formerly this had a much wider and more continuous range than it has at present. It is unfortunate that material of this taxon from the Sahara and Sudan is so meagre in our British herbaria. From what little is known about it there seems something in favour of regarding it as a link between *O. chrysophylla* and *O. europaea*.

We have then to hope for further investigations in the following directions :

1. The cytological investigation of the plants here grouped as *Olea chrysophylla* and of plants showing characters linking this with *O. europaea*.

2. Genetical experiments with *O. europaea* and its varieties and with *O. chrysophylla*.

3. The careful collecting of adequate material in flower and in fruit from the same individuals, especially in the Sudan, southern Egypt, and the southern Sahara, with comparative analysis of abundant and adequate new material.

In other words, it is doubtful if much progress can be made in determining the relationships of the wild and cultivated olives of the group here considered until the methods of the newer systematics have been applied.

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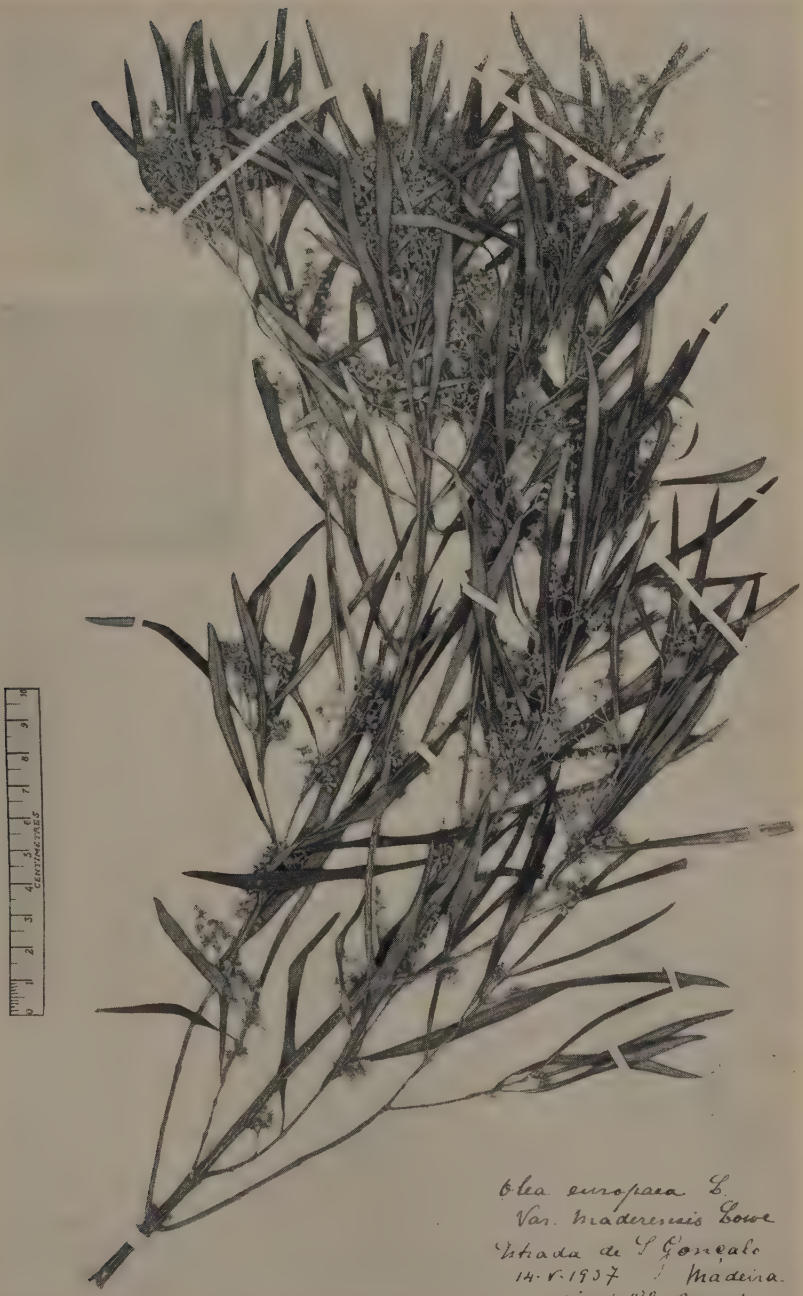
Additional note. The Index Kewensis makes *Olea africana* Miller, Gard. Dict. ed. 8, n.4 (1768) equivalent to *O. verrucosa* Link, Enum. Hort. Berol. **1,** 33 (1821). Adamson, in Adamson and Salter, Flora of the Cape Peninsula, 670 (1950) uses the name *O. africana* Mill. for the South African " Wild Olive " or " Olienhout ", and reduces *O. verrucosa* Link as a synonym. If this conclusion be correct and if *O. verrucosa* be included in the same aggregate species as *O. chrysophylla* the oldest specific name so far traced for the group would be *O. africana* Mill. and not *O. chrysophylla*. However, the evidence examined by the writer is meagre and unsatisfactory. No type specimen has been found after a long search in the Herbarium of the British Museum (Natural History). Miller's description says the leaf is " lanceolate ", not " linear-lanceolate " as he describes the leaf of the " Provence Olive ". Further, he quotes Boer., Ind. alt. **2,** 218 and translates the synonym as " African Olive with a long broad, shining leaf, of a greenish black above, and pale on its under side." The shine or polish of the upper surface of the leaf is several times emphasized. It seems very probable that Miller's plant was *O. laurifolia* Lam. and not *O. verrucosa* Link if his account be read comparatively against the descriptions he gives for the other species he recognizes. Unless further conclusive facts can be published the writer would prefer not to alter the application of well known names merely on nomenclatural grounds.

Plate 1.



Olea europaea L. var. *maderensis* Lowe. Collected : Madeira, Extrada de S. Goncalo, 14.5.37, *Barreto*.

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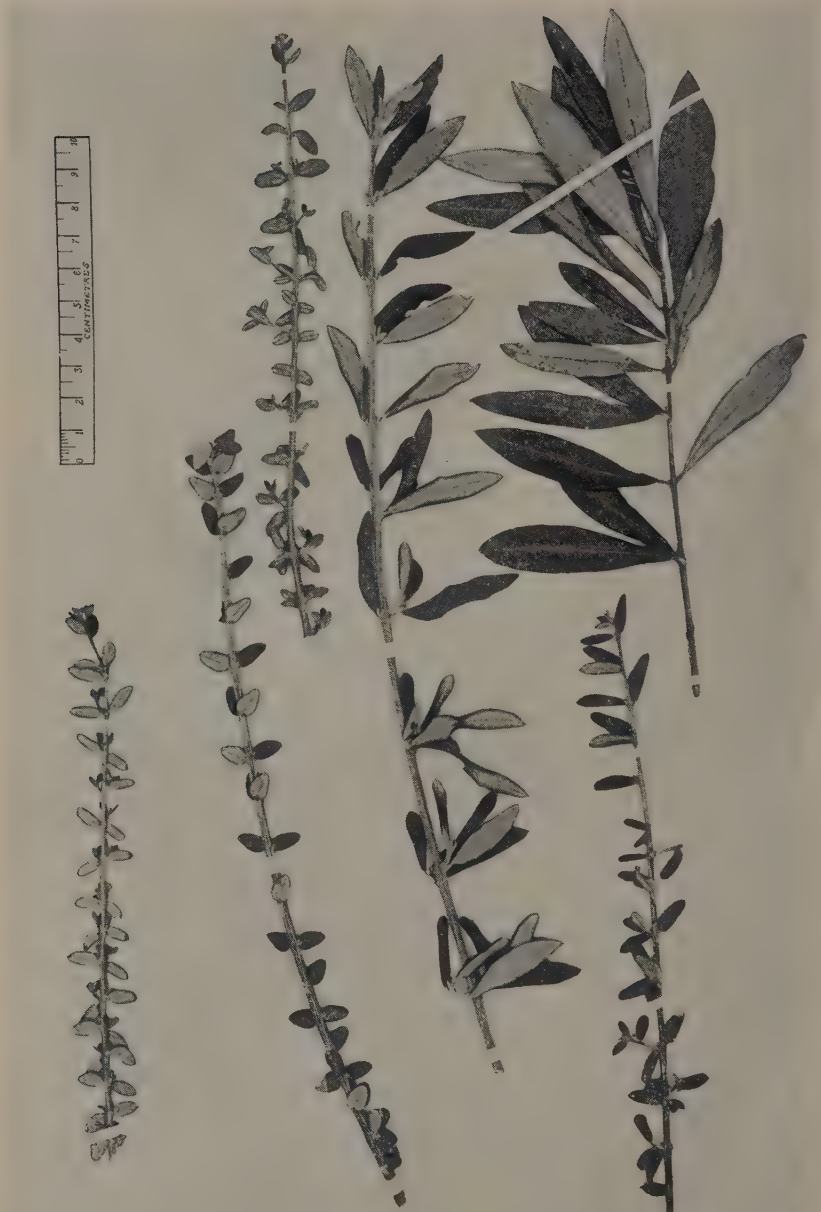
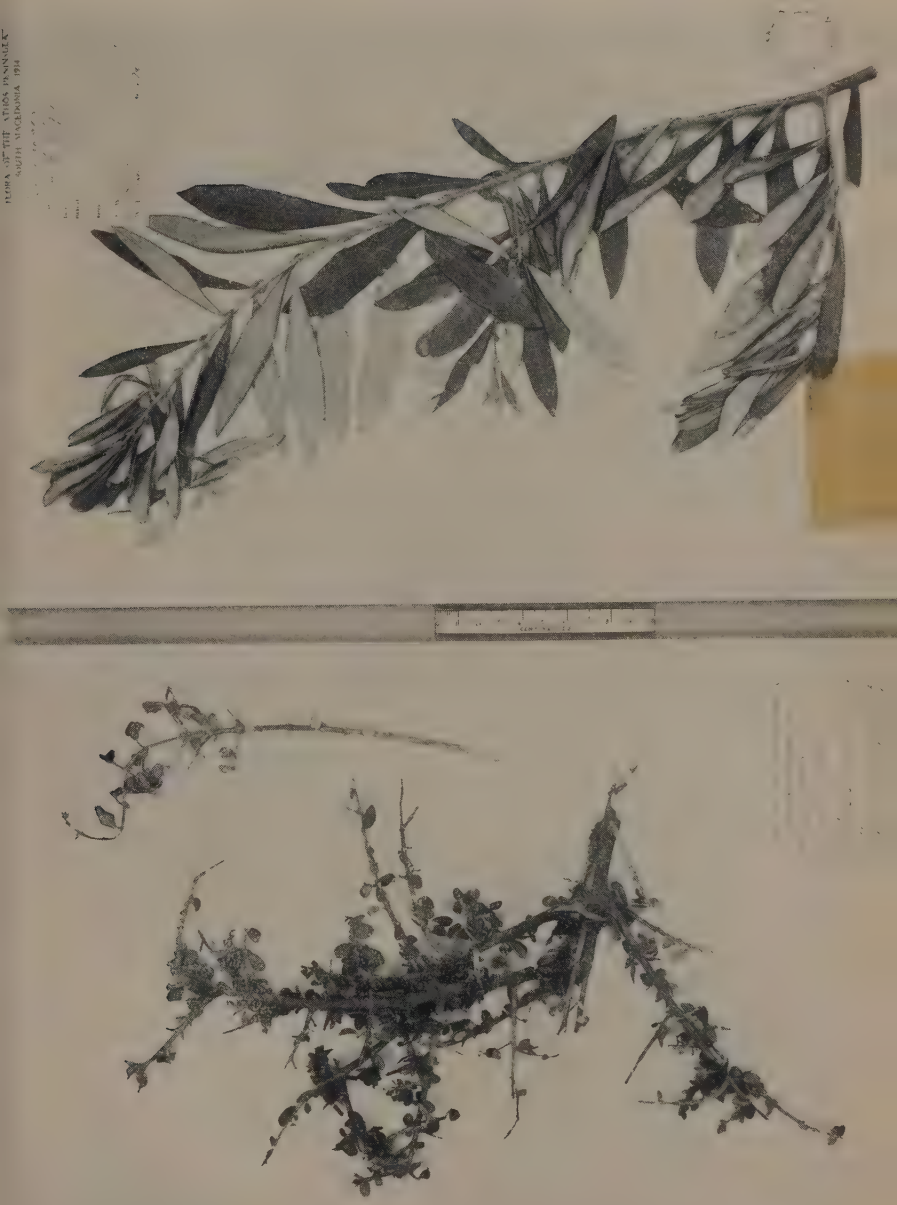
PLATE 2.



4. Olea europaea L. oleaster. Tree about 30 feet high. On road to Cape Spartel, near Tangier, Morocco. Collected 26/3/38.

Olea europaea L. " var. *oleaster* ".
Specimens showing range of leaf shape. Collected : Morocco on road to Cape Spartel, near Tangier, 26.3.38. *P. E. Newberry.*

Plate 3.



Olea europaea L.

Specimens gathered from the same tree to show range in branch habit and foliage characters. Collected : Athos Peninsula, south of Pyrgos, 24.4.1934, *Hill, Sandwith*, and *Turrill* 2745.

Plate 4.

Fig. 1. *Ecballium elaterium* (Linn.) A. Rich.

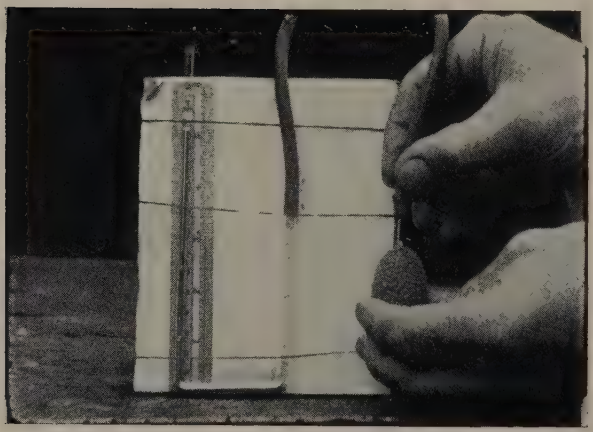


Fig. 2. Measuring the internal pressure of the fruit of *Ecballium elaterium* by means of a mercury manometer.

OBSERVATIONS ON THE INTERNAL PRESSURE OF THE RIPENING FRUIT OF ECBALLIUM ELATERIUM.

David Lewes, M.A., B.M., M.R.C.P.

The phenomenon of natural propagation by spontaneous ejection of seeds from the mature fruit of certain plants is well demonstrated by *Ecballium elaterium* (Squirting Cucumber). During a visit to Jersey, C.I., in August, 1950, the writer was so impressed by the remarkable properties of this plant (Figure I), that an attempt was made to determine the internal pressure by *direct* measurement. The experiments here recorded were carried out independently of the work of Obaton (1947) whose observations were, by contrast, based upon indirect inferences.

Obaton used high-speed cinematography to measure the velocity of the fluid column spontaneously ejected from mature specimens of *Ecballium elaterium*. He then constructed an apparatus capable of forcing water, under known pressure, through the natural opening of a recently discharged but eviscerated ripe specimen. Pressure was adjusted to deliver a jet of water having the same velocity as that observed in the first experiment. On the assumption that the relation between pressure and velocity remained constant in the two sets of experiments, Obaton concluded that the internal pressure at the moment of spontaneous rupture of *Ecballium* was 542 mm. Hg. or nearly three-quarters of an atmosphere.

Present Study

Apparatus :

A simple mercury manometer was constructed. A glass U-tube of 3 mm. internal diameter, calibrated with a millimeter scale, was connected by stout rubber tubing to a hypodermic needle of 1 mm. internal bore. A water-seal was established between the mercury column and needle tip before each pressure measurement was made.

Method :

Ripening fruit, which could be gently handled without rupturing, was removed from the plant by cleanly cutting across the stem as closely as possible to the fruit. The needle was then inserted vertically through the centre of the cut stem and gently advanced into the body of the specimen. (Figure II).

Results :

Maximal final pressures, with a mean value of $163{\cdot}8 \pm 4{\cdot}5$ mm. Hg., were recorded in five successful experiments (see Table).

An immediate rise in pressure was usual as the needle entered the body of the fruit, and the mercury rose rapidly, but intermittently, as the shaft of the needle was further advanced. A prominent feature of all successful experiments was the step-wise increase of pressure. On each occasion that this took place a distinct shock or vibration could be appreciated by the hand supporting the specimen. Final pressures were achieved by a sweeping circular movement of the needle. During this manoeuvre intermittent pressure increases of 20–30 mm. Hg., occurring simultaneously with the vibrations mentioned above, strongly suggested mechanical rupture of high-pressure compartments within the fruit.

TABLE

Experiment	*Pressure* (mm. Hg.)	*Comment*
1.	168	—
2.	165	—
3.	155	Slight leakage from needle
4.*	97	Leakage ; needle blocked
5.	165	—
6.	166	Slight leakage
7.*	110	Needle blocked
8.*	Nil	Immature specimens 2 in. long
9.*	Nil	Immature specimen 1¼ in. long
5 Successful expts.	163 ± 4·5	*excluded from calculation of mean pressure.

Commentary :

Availability of only a small number of specimens, suitable for experiment, limited the scope of the observations. Nevertheless, the results achieved, as well as failure to record significant pressure changes in immature specimens, strongly suggest the gradual building up of final pressures within the maturing fruit of *Ecballium elaterium*. They also suggest, as already stated, that the compartmental nature of the fruit may be an important contributory mechanism for raising the pressure to the levels necessary for spontaneous ejection of the seeds at full maturity.

The pressures here recorded are considered to be lower than the true pressure, because none of the specimens was fully ripe, and because the cubic capacity of the apparatus used was sufficiently large, as compared with the size of the fruit, to produce a significant pressure-lowering effect. Higher pressures would almost certainly be recorded by the use of a more sensitive recording device, such as a strain-gauge, or even a mercury manometer of narrower internal bore. It is suggested, however, that the high pressures estimated by Obaton, which are of the order of about three times those here observed, may well have been the result of the difference between the conditions which obtained in his experiments and those which obtain in nature.

SUMMARY

The internal pressures developing within the ripening fruit of *Ecballium elaterium*, measured by a simple mercury manometer, showed a mean value of 163·8 ± 4·5 mm. Hg. in five successful experiments. This figure is considered to be lower than the true pressure.

During pressure measurements the mercury column rose intermittently, and stepwise pressure increases of 20–30 mm. Hg. were accompanied by simultaneous shocks or vibrations within the fruit. It is therefore suggested that spontaneous rupture of high-pressure compartments may be a contributory factor in determining the final pressures which result in spontaneous ejection of the seeds at full maturity.

Reference

Obaton, M. F. (1947). Bull. Soc. Bot. France, **94** : 95.

I wish to thank Sir Edward Salisbury, F.R.S., for helpful suggestions and advice. I am also obliged to Mr. E. L. Wallace for facilities for carrying out the experiments, and to Mr. K. G. Moreman, A.R.P.S., for the photographs, which are enlargements from 16 mm. cinematograph film.

SOME NEW INDIAN GRASSES.

N. L. Bor.

Helictotrichon burmanicum *Bor*, sp. nov., ab aliis speciebus hujus generis arista recurvata haud torta et praecipue ab *H. aspero* (Munro) Bor glumis lemmatisbusque minoribus distinctum.

Gramen perenne. *Culmi* usque 100 cm. alti, teretes, striati, laeves glabrique, haud ramosi, nodis glabri. *Foliorum laminae* planae, flaccidae, lineares, in apicem validum pungentem attenuatae, sparse vel dense pilis albis brevibus plus minus obtectae vel paene glabrae, marginibus scabrae, utrimque plus minus laeves ; *vaginae* laeves, glabrae, striatae, laxiusculae ; *ligula* membranacea, 3 mm. longa, lacerata.

Panicula laxe spiculata, nutans, usque 24 cm. longa, 6–12 cm. lata ; rami usque 12 cm. longa, dimidia parte inferiore nudi ; axis laevis glaberque ; rami laeves glabrique sed apicem versus scabri. *Spiculae* 9–10 mm. longae, 2–3-florae, cuneatae. *Gluma inferior* 4–4·5 mm. longa, explanata 1 mm. lata, 1-nervis, lanceolata, marginibus hyalina, laevis, glabra ; *gluma superior* 5·5–6·5 mm. longa, 2 mm. lata, 3-nervis, oblongo-elliptica, acuta, laevis glabraque, marginibus hyalina. *Lemma* 6·5 mm. longum, 2 mm. latum, oblongo-ellipticum, apice fissum, lobis setaceis, dorso glabrum, laeve, apicem versus et carina minutissime scabrum, marginibus hyalinum, 5-nerve, aristatum ; *palea* 6–6·5 mm. longa, bicarinata, carinis scabra ; *arista* 2 mm. infra apicem dorso emergens, 9–10 mm. longa, recurvata, maturitate haud torta ; rhachillae articuli 2·5 mm. longi, ciliati ; *rhachilla* spiculae apice florem vestigialem gerens; *stamina* 3 ; *antherae* 1·5 mm. longae ; *ovarium* apice hirsutum ; *styli* 2 ; *stigmata* plumosa.

Burma. Myitkina, Hpimaw, 2200 m., 19 May, 1929, *Su Koe* 9962 (typus in Herb. Kew.).

This species can perhaps also be compared with *Helictotrichon parviflorum* Bor stat. nov. (*Avena aspera* Munro var. *parviflora* Hook. f., Flor. Brit. Ind., **7**, 277 : 1896) in which the spikelets are nearly similar in size. The differences can be summarised as follows :—

H. burmanicum	*H. parviflorum*
Lower glume lanceolate, 1-nerved.	Lower glume elliptic-acute, 3-nerved.
Panicle loose.	Panicle congested.
Rhachilla sparsely ciliate.	Rhachilla densely ciliate.
Awn not kneed, recurved, hardly or not at all twisted below the bend.	Awn kneed, twisted below the knee.

Oryzopsis humilis *Bor*, sp. nov., ab *O. laterale* Stapf spiculis late ellipticis, minoribus, valde recedit.

Gramen humile, caespitosum, perenne. *Culmi* usque 20 cm. alti, graciles, teretes, striati, laeves glabrique, nodis glabri. *Foliorum laminae* innovationum planae, interdum involutae, lineares, acutae, infra virides, supra glaucae, usque 7 cm. longae, 2 mm. latae, utrimque minutissime scabrae, marginibus scabrae, supra inter nervos rugosae, eae culmorum plerumque involutae, raro planae, utrimque marginibusque scabrae, in

apicem pungentem attenuatae ; *vaginae* innovationum laxae, breves, scariosae, a culmis solutae, laeves glabraeque, vel minutissime scaberulae, culmorum eae arcte complectentes, longiores, laevissimae, striatulae, glabrae ; *ligula* membranacea, 2·5–3 mm. longa.

Panicula stricta usque 5 cm. longa, usque 5 mm. lata ; axis, rami pedicellique plus minus scaberuli ; rami usque 5 mm. longi, erecti. *Spiculae* 4 mm. longae, 2·25 mm. latae, ambitu ellipticae, acutae, virides, apicibus purpurascentes. *Gluma inferior* 4 mm. longa, explanata 2·25 mm. longa, elliptica, acuta, haud acuminata, membranacea, 5-nervis, superne leviter carinata, carina scabra ; nervi laterales cum mediano anastomosantes ; *gluma superior* aequilonga, explanata 2 mm. lata, 3-nervis, superne carina obscura scabra. *Anthoecium* bisexuale, 3 mm. longum, 1 mm. latum, aristatum, oblongo-ellipticum ; *lemma* fusco-brunneum, pilosulum demum glabrescens, coriaceum demum crustaceum ; *palea* similis, 2-nervis, dorso lateribusque glabra ; arista recta, antrorse scabra ; styli 2 ; *stigmata* plumosi ; *lodiculae* 2, lanceolatae ; *stamina* 3 ; *antherae* 1·5 mm. longae ; *caryopsis* 2 mm. longa, 1 mm. lata, oblonga, teres ; *hilum* lineare, longum.

India Or. : Jaunsar, Rocks north of Deoban, 21 Jun. 1897, 2500 m., *J. F. Duthie* 19850 (a) (typus in Herb. Kew.) ; Lakandi Peak, 3 Jun. 1897, 2700 m., *J. F. Duthie* s.n.

This very neat species of *Oryzopsis* is distinguished from other Indian species, and particularly from *O. lateralis* Stapf, by the small spikelets which are broadly elliptic-acute in shape.

The species is represented at Kew by two gatherings only, both of them from inhospitable surroundings between 2,500 and 2,700 m.

Arthraxon santapaui *Bor*, sp. nov., *A. micanti* (Nees) Hochst. similis sed ab eo spiculis multo majoribus pedunculo piloso distinctus.

Gramen annuum. *Culmi* graciles, striati, teretes, nodis et infra paniculam pilosi, ceterum glabri. *Foliorum laminae* ovato-acutae vel ovato-acuminatae, utrimque marginibusque pilis longis e tuberculis ortis obtectae, usque 4 cm. longae, 10 mm. latae, flaccidae, virides, marginibus scabrae ; *vaginae* laxae, a culmo solutae, compressae, carinatae, laeves vel tuberculis pilorum caducorum scabrae ; *ligula* ad seriem densorum ciliorum redacta.

Racemi 2–3 usque 3 cm. longi ; rhacheos fragilis articuli filiformes ciliati ; spiculae ad quemvis rhacheos nodum solitariae, demum cum rhacheos articulo accumbente et pedicello vestigiale decidentes ; pedunculus longe-exsertus, curvulus, infra paniculam pilosa ; racemi articuli 3·5 mm. longi, graciles, pilis albis longe-ciliati ; *pedicellus* circiter 3 mm. longus, articulis similis sed gracilior ; spicula pedicellata nulla. *Spicula sessilis* 7·5 mm. longa, a latere leviter compressa, lanceolato-acuta ; *gluma inferior* 7·5 mm. longa, 1·5 mm. lata, lanceolato-acuta, 7-nervis, dorso rotundata, dorso praecipue superne spinulosa ; *gluma superior* glumae inferiori aequilonga vel paullo longior, compressa, 3-nervis, marginibus hyalina, obscure carinata, dorso scabra, superne paucis pilis longis instructa. *Anthoecium inferius* vacuum ; *lemma* hyalinum, lanceolatum, 3 mm. longum ; *palea* nulla ; *anthoecium superius* ♀ ; *lemma* 3 mm. longum, hyalinum, explanatum lanceolato-acutum, apice breviter

bidentatum ; dentes setosae ; *arista* subbasalis, 1·8 cm. longa ; *columna* 8 mm. longa, torta ; *stamina* 2 ; *antherae* 0·8 mm. longae ; *styli* 2 ; *stigmata* plumosa.

India Or. : Bombay, Purandhar Fort, 10 Oct. 1950, *H. Santapau* 11450a (typus in Herb. Kew.).

This graceful species was gathered in the roots of a specimen of *Ischaemum impressum* Hack. collected by Father Santapau in Purandhar Fort, Bombay. It is distinguished from other Indian species of the genus by the long exserted, pilose, curved peduncle and large spikelets.

The conditions under which it was collected seem to indicate that an examination of the roots of the taller species of grass growing thickly in grassland in Bombay would be very profitable. At Kew I have frequently found species which are looked upon as rare, lurking at the base of other taller grasses. Such species are *Bhidea burnsiana* Bor, *Danthonidium gammiei* (Bhide) C. E. Hubb., *Arundinella spicata* Dalz., and small species of *Dimeria*.

Habitats such as these, which have a microclimate of their own and therefore present conditions which are quite different from those found in the open or even those at the tops of the inflorescences of the taller grasses, have not been systematically explored. Grasses which prefer such habitats, in which light and humidity factors are so different from those enjoyed by their competitors, must have a different constitution. It is expected that a systematic search may bring further novelties to light.

Arthraxon sikkimensis *Bor*, sp. nov. *A. lancifolio* (Trin.) Hochst. similis sed ab eo spiculae sessilis gluma inferiore costata valde differt.

Gramen annuum. *Culmi* gracillimi usque 15 cm. alti, laeves glabrique, striati, nodis hirsuti. *Foliorum laminae* ovato-acutae, usque 1·5 cm. longae, 5 mm. latae, utrimque granulosae, utrimque plus minus pilosae, glaucae, marginibus cartilagineis scabrae ; *vaginae* inflatae, internodiis longiores ; *ligula* 1·5–2 mm. longa, membranacea, truncata.

Racemi 2–3, 1–2 cm. longi, pedunculo longe exserto insidentes vel vagina superiore emergentes ; racemorum rhachis fragillima ; articuli 2·5 mm. longi, graciles, compressi, angulis ciliati ; pili inferne breviores superne longiores. *Spiculae* ad quemvis rhacheos nodum binae, altera pedicellata, pedicello 2 mm. longo, gracile, ciliato. *Spicula sessilis* oblonga vel lanceolata, acuta, cum callo hirsuto 0·5 mm. longo, 3·5 mm. longa ; *gluma inferior* 3 mm. longa, explanata 1·25 mm. lata, 7-nervis, 7-costata, laevis glabraque, costis superne scabra ; *gluma superior* 3·75 mm. longa, hyalina, compressa, 3-nervis, laevis glabraque, oblongo-acuta, apice brevissime mucronulata ; *anthoecium inferius* vacuum ; *lemma* hyalinum 2 mm. longum, lanceolatum; *palea* nulla ; *anthoecium superius* ♀, *lemma* 2 mm. longum, oblongo-acutum, aristatum ; *arista* sub-basalis, 8 mm. longa ; *columna* 3·5 mm. ; *stamina* 2 ; *antherae* 0·6 mm. longae, purpureae. *Spicula pedicellata* 2·5 mm. longa, compressa ; *gluma inferior* 2-carinata, marginibus involuta, carinis scabra, 5-nervis ; *gluma superior* aequilonga, carinata, 3-nervis ; *lemma* 2 mm. longum, hyalinum ; stamina 2 ; *antherae* vestigiales.

India Or. : Sikkim ; Lachung, 31 Aug. 1892, 2,800 m., *G. A. Gammie* 1079 (typus in Herb. Kew.) ; Yakla, 3000 m., 20 Oct. 1869, *C. B. Clarke* 10270 ; Lachung, 3–3,500 m., 29 Aug. 1849, *J. D. Hooker*.

This very slender and graceful grass is found at high altitudes in Sikkim only. At first glance it resembles *A. lancifolius* (Trin.) Hochst. to a remarkable degree, but is easily separated from it by the lower glume of the sessile spikelet which in *A. sikkimensis* is prominently 7-ribbed.

Ischaemum dalzellii *Stapf* mss., sp. nov., *I. semisagittato* Roxb. affine sed ab eo rhacheos articulis lineari-clavatis haud turbinatis facile distinguitur.

Gramen annuum. Culmi numerosi, basi decumbentes, dein ascendentes, laeves glabrique, nitentes, infra nodos striati. *Foliorum laminae* basi sagittatae, petiolatae, inferiorum petioli usque 5 cm. longi, superiores sessiles, lineari-acuminatae vel acutae, usque 7 cm. longae, ad 1·4 cm. latae, utrimque pilis mollibus basi tuberculatis conspersae, marginibus scabrae, eae vaginarum superiorum vestigiales ; *vaginae* inferiores laxiusculae, herbaceae, leaves glabraeque, paucis pilis longis albis superne exceptis ; superiores arctae, culmos complectentes, eae inflorescentiam lateralem suffulcientes scariosae, rufescentes, explanatae, elliptico-acutae, 6 cm. longae, sine laminam ; *ligula* membranacea, 4 mm. longa, dorso pilosa.

Racemi bini, 4–6 cm. longi, pedunculus inflorescentiae terminalis longe-exsertus, ei inflorescentiarum lateralium breviores, usque 5–6 mm. longi. Spiculae ad quemvis rhacheos nodum binae, pedicellata a pedicello demum soluta, sessilis demum cum rhacheos articulo accumbente disjungens ; articuli clavati, 3·5 mm. longi, externe rotundati, interne plani, duobus angulis dorsoque pilis albis longis pilosi. *Spicula sessilis* ; *gluma inferior* 5–5·5 mm. longa (cum callo 1 mm. longo), oblongo-obtusa, dorso rotundata vel plana, bicarinata, marginibus anguste involutis, carinis scabra, superne carinis anguste alata, pilis longis albis dorso calloque tecta ; *gluma superior* 4·5–5 mm. longa, lanceolato-acuta, compressa, carinata, 3-nervis, superne carina curvata, carina dorsoque scabra. *Anthoecium inferius* ♂ ; *lemma* lanceolato-acutum, hyalinum, 3-nerve, 4·5 mm. longum ; *palea* bicarinata ; *stamina* 3 ; *antherae* 2·5 mm. longae. *Anthoecium superius* ♀ ; *lemma* 3 mm. longum, hyalinum, 3-nerve, ad medium fissum, aristam validam ex fissura emittens; lobi acuminati, ciliati ; *palea* squama hyalina ; *arista* 1·4 cm. longa ; *columna* torta, circiter 7 mm. longa ; *stamina* 3 ; *antherae* 3·5–4 mm. longae. *Spicula* pedicellata ; *pedicellus* brevissimus, circiter 0·5 mm. longus ; spiculae partes eis spiculae sessilis similes sed lemma superior integrum, exaristatum ; anthoecii inferioris antherae 1·5 mm. longae, eae superioris 3 mm. longae.

India Or. : Bombay : Yellapur, 25 Oct. 1884, "roadsides in forest," common, *W. A. Talbot*, 738 (typus in Herb. Kew.). Ceylon : near Colombo, *W. Ferguson*, C.P. 3263 (*I. conjugatum* Roxb.).

Ischaemum inerme *Stapf* mss., sp. nov., *I. semisagittato* simile sed ab eo racemis exaristatis spiculis longioribus facile distinguitur.

Gramen annuum. *Culmi* usque 70 cm. alti, basi decumbentes, radicibus multis longis nodis inferioribus, laeves glabrique, striati, nodis glabri. *Foliorum laminae* lineares, acuminatae, basi sagittatae, usque 15 cm. longae, 20 mm. latae, superiores vestigiales, infra glabrae laevesque, marginibus scaberrimae, inferiores petiolatae (petiolus 2 mm. longus) ; *vaginae* inferiores superioresque arctae, culmos complectentes, alterae laxiusculae, glaberrimae, laeves, pilis albis superne e tuberculis ortis exceptis, herbaceae, eae inflorescentiam lateralem suffulcientes sine laminam, scariosae, spathiformes, 6·5 cm. longae ; *ligula* membranacea, 3 mm. longa.

Racemi bini, usque 9 cm. longi, sed plerumque breviores, 4–5 cm. longi; racemi terminales plerumque, paene semper, exaristati, racemi inferiores nunc aristati nunc exaristati vel spiculae racemi superiores aristatae inferiores exaristatae vel omnes aristatae. *Racemus exaristatus* ; articuli turbinati, sectione semicirculares, laeves glabrique. *Spicula sessilis* ; *gluma inferior* 6·5 mm. longa (cum callo 1 mm. longo) in inferiore dimidia parte coriacea, rugis transversis humilibus, in superiore dimidia parte herbacea, nervis multis, ambitu triangularis, bicarinata, glabra vel pilis brevissimis obtecta, interdum racemi apicem versus pilis albis 3 mm. longis obtecta ; *gluma superior* 3-nervis, carinata, navicularis, carina scabra. *Anthoecium inferum* ♂ ; *lemma* late lanceolatum, acutum, 7 mm. longum, 7-nerve, 2-carinatum, carinis superne ciliatum ; *palea* 7 mm. longa, 2-nervis, bicarinata ; *stamina* 3 ; *antherae* 3 mm. longae ; *lodiculae* 2, cuneatae. *Anthoecium superius* ♀ ; *lemma* 5·5 mm. longum, hyalinum, brevissime bifidum, 3-nerve, breve aristata ; *palea* aequilonga, 2-carinata ; *styli* longissimi ; *stigmata* plumosa. *Spicula sessilis* aristata ; spiculae partes eis spiculae sessilis exaristatae (1) glumis inferioribus calloque pilis albis brevibus vel longis dense tectis (2) lemmate superiore, 5 mm. longo, ad medium fisso et e fissa aristam 1·5 cm. longam emittente, exceptis ; *anthoecium inferum* ♂ ; *antherae* 3 mm. longae ; *anthoecium* superius ♀ ; *antherae* 2·5 mm. longae. Spicula pedicellata spiculae sessili simillima, sed anthoecio inferiore vacuo, anthoecio superiore masculino differt ; stamina 3 ; antherae 2·5 mm. longae ; pedicellus brevis, cum callo 1 mm. longus.

India Or. : Bombay, Bandra, Oct. 1896. *R. C. Wroughton* (typus in Herb. Kew.).

The sessile and pedicelled spikelets of this species are identical in appearance, outwardly indistinguishable were it not for the extremely short pedicel upon which the pedicelled spikelet is seated. The lower pairs of spikelets are almost invariably smooth, glabrous and shining, but toward the middle and upper parts of the raceme the spikelets are at first very shortly tomentose and finally bear in addition long, white, delicate hairs 3 mm. or more long.

Ischaemum ritchiei *Stapf* mss., sp. nov., *I. semisagittato* Roxb. simile, sed ab eo spiculis sessilibus pedicellatisque angustissimis gluma spiculae sessilis inferiore rugulosa et marginibus nodulosa recedit.

Gramen annum, radicibus e nodis inferioribus numerosis. *Culmi* erecti, geniculatim ascendentes, usque 80 cm. alti, inferne nodis brevioribus aggregatis, laeves, nitentes, nodis glabri, ramosi ; rami floriferi.

Foliorum laminae basi sagittatae, petiolatae (petioli laminarum inferiorum usque 8 cm. longi), lineares vel ellipticae, acuminatae, planae, flaccidae ; laminae inferiores c. 21 cm. longae, 1·5 cm. latae, eae medii usque 11 cm. longae, 2·0 cm. latae, sed superiores vestigiales, glabrae, marginibus scabrae vel laeves ; *vaginae* scariosae, herbaceae, laxissimae, laeves glabraeque, superiores spathiformes ; *ligula* membranacea, 8 mm. longa, lacerata.

Racemi bini ; spiculae ad a quemvis rhacheos nodum bini, sed tria paria inferiora glabra haud disjungentia, superiora pilosa demum disjungentia ; articuli rhacheos inferioris sectione 2-angulati, interne plani, externe rotundati, superne incrassati, laeves glabrique, circiter 6 mm. longi ; articuli superiores similes sed angulis ciliati. *Spicularum paria inferiora exaristata* ; *Spicula sessilis* ; *gluma inferior* 8 mm. longa (cum. callo 1 mm. longo), in ¾ parte coriacea, marginibus nodulis et dorso rugis validis notata ; *gluma superior* 6·5 mm. longa, oblongo-acuta, 3-nervis, glabra, carinata, carina scabra. *Anthoecium inferius* vacuum ; *lemma* oblongo-lanceolatum, acutum, 6 mm. longum, 3-nerve ; palea aequilonga, angustior, 2-nervis, 2-carinata, anguste carinis alata. *Anthoecium* superius ♀ ; *lemma* 5 mm. longum, hyalinum, 3-nerve, apice bilobatum, e fissura brevem setam emittens ; *palea* aequilonga, angustior, 2-nervis ; *styli* longiusculi, 2 ; *stigmata* purpurea, plumosa, *Spiculae pedicellatae* ; *gluma inferior* 6 mm. longa, ei spiculae sessilis similis, anthoecio inferiore vacuo, anthoecio superiore ♂, lemmate haud fisso mucronato. *Spicularum paria superiora aristata* ; *spicula sessilis* ; *gluma inferior* 6 mm. longa, elliptico-acuta, dorso plana sine rugos sed marginibus nodulis notata, callo dorsoque pilis albis dense tecta ; *gluma superior* 5–6 mm. longa, oblong-acuto, navicularis, superne dorso curvata, 3-nervis, carina dorsoque scabra. *Anthoecium inferius* ♂ ; lemma hyalinum, late oblongo-lanceolatum, acutum, 3-nerve ; *palea* aequilonga, angustior, 2-nervis ; *stamina* 3 ; *antherae* 3 mm. longae. *Anthoecium superius* ♀ ; *lemma* 4·5 mm. longum, 3-nerve, ad medium fissum, e fissura aristam brunneam imperfectam emittens ; *styli* longissimi ; *stigmata* plumosa.

India Or. : Bombay : Kanara, Ritchie (fide Munro) (typus in Herb. Kew.).

This is a most remarkable species of *Ischaemum* and can be recognised at a glance. The sessile and pedicelled spikelets are extremely narrow in comparison to their length, and the teeth or nodules on the adjacent margins are enmeshed.

Ischaemum tumidum *Stapf* mss., sp. nov., *I. semisagittato* Roxb. simile sed foliorum basibus cordatis haud sagittatis, petiolatisque differt.

Gramen annuum. *Culmi* numerosi, basi decumbentes, dein ascendentes, graciles, laeves glabrique, nitentes, nodis glabri vel pilosi. *Foliorum laminae* ambitu triangulares vel oblongo-ovatae, basi latae, truncatae, utrinque glabrae laevesque, usque 5 cm. longae, 13 mm. latae, marginibus scaberrimae, apice crasso acuto ; *vaginae* inferiores superioresque laeves glabraeque vel paucis pilis albis marginibus, striatulae, arctae ; eae ramos floriferos fulcientes laxae, laeves glabraeque, foliis normalibus ; eae inflorescentias laterales fulcientes sine laminam vel lamina vestigiale ; *ligula* 1·5 mm. longa, ciliata.

Inflorescentia pedunculo longe exserto terminalis vel ramis lateralibus pedunculo breve (3 mm. longo) et vagina spathiforme fulta ; vagina spathiformis 4·5 cm. longa. Racemi bini, usque 3 cm. longi. *Spiculae* ad quemvis rhacheos fragilis nodum binae, una pedicellata a pedicello demum soluta, altera sessilis demum cum rhacheos articulo accumbente disjungens ; articuli 3·5 mm. longi, late clavati, tumidi, sectione biangulares, externe dorso rotundati, interne plani tenuesque, dorso pilis brevissimis tecti vel glabrescentes. *Spicula sessilis* ; *gluma inferior* (cum callo 1 mm. longo) 6 mm. longa, oblongo-acuta, truncata, bicarinata, carinis anguste involuta, nonnullis nodulis indistinctis marginibus, nonnumquam rugosa, carinis anguste alatis scabra ciliataque, omnino dorso pilis albis brevibus tectae, pilis longioribus multis interspersis, vel glabrescens vel glabra ; *gluma superior* 6 mm. longa, navicularis, 3-nervis, superne dorso curvata, pilis multis albis brevissimis villosa. *Anthoecium inferius* ♂ ; *lemma* lanceolato-acutum, hyalinum, 3-nerve, 4 mm. longum ; *palea* aequilonga, hyalina, 2-nervis ; *stamina* 3 ; *antherae* 2·5–3 mm. longae. *Anthoecium superius* ♀ ; *lemma* 4 mm. longum, ad medium fissum, 3-nerve, e fissura aristam validam perfectam emittens ; *palea* aequilonga, hyalina ; *arista* 14 mm. longa ; *columna* 7 mm. long, torta, castanea. *Spicula pedicellata* ; *pedicellus* circiter 1 mm. longus, villosus ; *gluma* inferior 4 mm. longa, altero margine longe ciliata ; alterae partes eis spiculae sessilis similes sed minores ; *lemma superior* latum, lanceolato-acutum, non fissum, exaristatum.

India Or.: Madras: Concan, Stocks (typus in Herb. Kew.). Bombay: Khandala, St. Xavier's Villa, 17 May 1949, *H. Santapau* 10031.

Themeda mooneyi *Bor*, sp. nov., *T. tremulae* Nees comparanda sed ab ea pedunculis multo longioribus satis recedit.

Gramen perenne, gracile, erectum. *Culmi* usque 40 cm. alti, teretes, nitentes, duri, laeves glabrique, fere nodis omnibus ramosi ; rami erecti, foliosi. *Foliorum laminae* lineares, in apicem longum setaceum attenuatae, usque 30 cm. longae, 4 mm. latae, utrinque scaberrimae, basi leviter vel haud contractae, infra glabrae, supra basin versus pilis longis albis e tuberculis ortis obtectae ; *vaginae* validae, culmum arcte complectentes, compressae, carinatae, striatae, laeves glabraeque vel superne scaberulae ; *ligulae* membranaceae, 1·5 mm. longae, albae, laceratae, externe scabrae.

Panicula suberecta ; racemi solitarii pedunculis glabris ex spathis propriis 5 cm. longis exeuntibus ; pedunculus glaber, filiformis. *Spiculae involucrantes* in paria alterna dispositae ; *gluma inferior* 11 mm. longa (eae unius paris 2 mm. latae, eae alius paris angustiores) elliptico-acuta, plana vel leviter convexa, 2-carinata, carinis anguste alata, marginibus anguste involutis, multi-nervis, alarum marginibus scabra, dorso omnino dense vel sparse pilis albis e tuberculis ortis tecta ; *gluma superior* brevior, oblongo-elliptica, acuta, 3-nervis, hyalina, marginibus ciliata ; *anthoecium inferius* ♂ ; *lemma* elliptico-oblongum, acutum, hyalinum, 7·5 mm. longum ; *palea* oblongo-obtusa, hyalina, 7 mm. longa, marginibus ciliata ; *lodiculae* 2, oblongo-truncatae ; *stamina* 3 ; *antherae* 3–3·5 mm. longae. *Paria superiora* heterogama 2, summum cum spicula terminali ♂ ternionem efficiens. *Spiculae sessiles* teretes, leviter dorso-ventricale

compressae, brunescentes, demum fusco-brunneae, cum callo 1·5 mm. longo obtuso pilis rufis densis tecto, 6·5 mm. longae ; *gluma inferior* 5 mm. longa, explanata 2 mm. lata, ambitu oblongo-truncata, coriacea, dorso leviter depressa, granulata, lateribus et dorso apicem versus scabra ; *gluma superior* inferiori aequilonga, coriacea, brunescens demum brunnea dorso costata, anguste marginibus involuta ; *anthoecium inferius* vacuum ; *lemma* hyalinum, triangulare ; *palea* nulla ; *anthoecium superius* ♀ ; *lemma* hyalinum, in validam aristam 2·5–4·5 cm. longam exiens ; aristae columna 1·5–2·5 cm. longa, fusco-brunnea, torta ; *palea* nulla. *Spiculae pedicellatae* ; pedicellus 2 mm. longus, planus ; *gluma inferior* 8·5 mm. longa, lanceolato-acuminata, explanata 1 mm. lata, multinervis, lateribus rotundata sed superne carinata, dorso glabra, carinis apicem versus scabra ; *gluma superior* lanceolato-acuta, 3-nervis, laevis, glabra, marginibus ciliata ; *anthoecium inferius* ♂ ; *lemma* hyalinum, 6 mm. longum ; *palea* aequilonga sed angustior ; *stamina* 3 ; *antherae* 3·5 mm. longae ; *lodiculae* 2, magnae, truncatae.

Ind. Or. : Orissa, near Pottangi, Koraput Dist., 1300 m., 10 Oct. 1950, *H. F. Mooney* 4064 (typus in Herb. Kew.). " A common grass above 4000 ft. on Turia Konda (and elswhere) ascending to 5,500 ft." ; Above Nelpada village, near Pottangi, Koraput Dist. 1200–1300 m., 8 Oct. 1950, *H. F. Mooney* 4034, " A grass growing gregariously on the face of a granite cliff ".

Themeda saxicola *Bor*, sp. nov., *T. hookeri* (Griseb.) A. Camus comparanda sed ab ea et omnibus aliis speciebus racemo singulo culmis haud ramosis facile distinguitur.

Gramen perenne, gracile, radice lignoso. *Culmi* usque 35 cm. alti, graciles, teretes, laeves glabrique, simplices haud ramosi, basi vaginis altis brevioribus pilosis tecti, foliis basi plerumque gregatis. *Foliorum laminae* inferiores lineari-acuminatae, in apicem validum attenuatae, usque 6 cm. longae, 2·5–3 mm. latae, infra glabrae, supra pilis longis albis e tuberculis ortis praecipue marginibus instructae, utrimque marginibusque minutissime scabrae ; laminae superiores breves vel vestigiales, erectae ; *vaginae* culmum arcte complectentes, nodis breviores, carinatae, glabrae, laeves ; inferiores brevissimae inter venas pilosae ; *ligula* brevissima, 1 mm. longa, membranacea, margine superiore ciliata.

Racemus solitarius ; spiculae involucrantes duo paria homogama ; paria superiora heterogama duo, summum cum spicula terminali ♂ trionem efficiens ; pedunculus 5 cm. longus, glaber, gracillimus, vagina spathiforme exiens. *Spiculae* involucrantes in paria alterna dispositae, spiculae paris unius inaequilongae, altera 1,3–1·5 cm. longa, altera 1·1 cm. longa ; *gluma inferior* 1·1–1·5 mm. long, oblique elliptico-acuta, plana vel dorso leviter convexa, multinervis, 2-carinata, carinis anguste alata, glaberrima, laevis, purpurascens vel viridis ; alae purpurascentes ; *gluma superior* triplo brevior, hyalina, 3-nervis, laevis, glabra, marginibus ciliata ; *anthoecium inferius* ♂ ; *lemma* hyalinum, marginibus ciliatum ; *palea* aequilonga sed angustior ; *stamina* 3 ; *antherae* 3·5–4 mm. longae. Spicula sessilis cum callo 2 mm. longo pungentissimo curvulo antice glabro lateribus et postice dense fusco-barbato, 7·5–8 mm. longa, teres, leviter compressa ; *gluma inferior*, explanata oblonga, truncata, pilis brevibus

brunneis densis tecta, coriacea demum crustacea, 5-nervis, dorso minute scabra, marginibus apicem versus scaberrima, viridis demum fusco-brunnea ; *gluma superior* oblongo-truncata, membranacea ; *anthoecium inferius* vacuum ; lemma triangulare, hyalinum, 4 mm. longum ; *palea* nulla ; *anthoecium superius* ♀ ; *lemma* aristae validissimae basis hyalina, 3 cm. longae ; *columna* 2 cm. longa, brunnea, torta, scabra ; *styli* 2 ; *stigmata* plumosa ; *antherae* nullae. *Spiculae pedicellata* ; pedicellus 2·5 mm. longus, gracilis, compressa ; *gluma inferior* 1 cm. longa, elliptica, acuta, multinervis, lateribus rotundata, marginibus ciliata ; *gluma superior* circiter 9 mm. longa, 3-nervis, dorso rotundata, marginibus ciliata ; *lemma inferius* hyalinum ; *palea* nulla ; *lemma superius* hyalinum, breve ; *stamina* 3 ; *antherae* 3·5–4 mm. longae.

Ind. Or. : Orissa, Raisili Village, Koraput Dist., 1000 m., 25 Oct. 1950, *H. F. Mooney* 4241 (typus in Herb. Kew.). " In patch of shallow soil over granite-gneiss, moist July–October only."

This species is quite unique in the genus *Themeda* in that the inflorescence is a solitary raceme terminating the tip of an unbranched culm. The habitat is one that must demand much from the plants growing upon it. The soil is shallow, overlying granite-gneiss, and is only moistened for a short period of the year. Elsewhere in India annuals counter such conditions by completing the life cycle from seed to seed in the short period during which climatic conditions are favourable to plant growth. *Themeda saxicola* and *T. mooneyi* are, however, both perennials and must possess exceptional powers of resistance to dessication. These isolated hills in Orissa rise to considerable altitudes and obviously would be expected to provide a number of novelties.

THE GENUS ORINUS HITCHC.

N. L. Bor.

The genus *Orinus* was erected by Hitchcock in 1933 in the Journal of the Washingston Academy of Sciences, vol. **23,** p. 136, to accommodate a grass which had been collected at high altitudes in Ladak, Kashmir, by Walter Koelz. This new genus he considered to differ from " *Leptochloa* sect. *Diplachne* and *Trichoneura,* in the entire awnless apex of the lemma and in the villous pubescence evenly distributed over the surface of the lemma instead of confined to the nerves ". The species was called *Orinus arenicola* Hitchc.

This was not, however, the first occasion on which this grass had been collected, for it was found in Tibet by Surgeon-Captain W. G. Thorold in 1891, and it was then called *Diplachne thoroldi* Stapf by the late Dr. O. Stapf. It has been collected in Tibet on two subsequent occasions. Koelz' specimen is the first record from the Western Himalaya and the first record from India. The type sheet of *Diplachne thoroldi* Stapf is in the Kew Herbarium.

Hitchcock has enumerated the differences between *Orinus* and *Diplachne,* the genus to which it is most closely related, but he might have added that the grain is terete not dorsally flattened and the glumes are much thinner

in texture when compared with the lemmas. At any rate the characteristics of this grass are sufficiently distinct for it to form the type of a separate genus.

This species is one of those very highly specialised grasses, e.g., *Psammochloa*, *Ammophila*, etc., which flourish in sandy places and which obviously are excellent sand binders. These grasses depend for their success on the long scaly rhizomes which are produced in large numbers and spread radially in all directions from the base of the plant, forming an interlacing network below the surface of the sand. The rhizomes of *Orinus* are covered with distichously arranged overlapping scales.

Where the rhizome comes to the surface buds are produced in the axils of the scales. Flowering shoots arise from these and, below the surface, roots and new rhizomes are developed. The roots are abundantly covered with very woolly roothairs which enable the plant to take advantage of intermittent rainfall and to extract all possible moisture from the soil.

It is quite understandable how the intricate network of roots helps to stabilise shifting sands. But as these sands are caused to move by winds, the stems themselves also help in stabilisation by diminishing the speed of the wind whereby the load of sand carried along is deposited.

As this grass may eventually be of importance in checking erosion and holding sandy soils, a revised description of the genus in Latin and an adequate description of the grass in English are given below.

Orinus *Hitchc.* emend. *Bor.*

Spiculae elliptico-acutae vel demum cuneatae, 2-, 3-, rarius 4-florae, pedicellatae, racemosae ; *glumae* fere aequales ; inferior brevior, 1-nervis ; superior 3-nervis, utraeque translucentes, glabrae vel plus minus dorso longiusculis pilis albis tectae ; *lemma* juventute flavum, demum purpureo-nigrum vel nigrum, glumis paullo longius, explanatum oblongo-obtusum, 3-nerve, dorso omnino pilis albis tectum vel demum glabrescens ; *palea* lemmate brevior angustiorque, 2-carinata, dorso laterisbusque pilosa, carinis ciliata ; *stamina* 3, antheris flavis ; *styli* 2 ; *stigmata* plumosa ; *rhachilla* glabra, supra glumas et infra flores disarticulans ; *lodiculae* 2, cuneato-truncatae.

Gramina perennia, arenosis altis incola, rhizomatibus longis rigidis ubique repentibus, squamis coriaceis distichis tectis ; *culmi* erecti, teretes, nodis glabri ; *foliorum laminae* planae demum involutae ; *vaginae* arcte culmum complectentes ; *ligulae* membranaceae.

Species adhuc unica in Asiae altis arenosis incola.

Orinus thoroldii (*Stapf*) *Bor* comb. nov. *Diplachne thoroldii* Stapf ex Hemsl. in Jour. Linn. Soc. Bot. **30,** 121 (1894).

Orinus arenicola Hitchc. in Journ. Wash. Acad. Sci. **23,** 136 (1933).

A perennial grass with woolly roots, sending out radially from the base long rhizomes covered with hard, overlapping, coriaceous, striate, polished scales ; the rhizomes on reaching the surface produce buds in the axils of the scales and these develop into erect culms. *Culms* erect, up to 50 cm. tall, clothed with scarious sheaths at the base, smooth and

glabrous, striate, glabrous at the nodes. *Leaf-blades* flat, finally involute, rounded or almost square at the base, or hardly contracted, with a curious transverse band of lighter colour at the junction of base and the sheath, linear-acuminate in shape, ending in a firm, sharp point, very glaucous, up to 15 cm. long by 4 mm. broad, minutely scabrid on the margins, deeply furrowed between the veins on the upper surface, often densely hirsute on the lower and upper surfaces with hairs from bulbous bases ; *sheaths* closely clasping the culms, striate, more or less hirsute, particularly towards the margins and below, with bulbous-based hairs ; lower sheaths scarious and glabrous, insensibly merging into the coriaceous scales of the rhizomes ; *ligule* about 1 mm. long, membranous, lacerate.

Inflorescence a panicle up to 15 cm. long, of 4–8 racemes 1–7 cm. long, at first erect, then, especially the lowest, declinate on a slender, glabrous, striate axis ; axis of the racemes similar but more slender, with a large, often hairy, gland on the inner surface at its junction with the main axis. *Spikelets* wedge-shaped, dark to almost black, 7–9 mm. long, 2–3-, rarely 4-flowered, seated on smooth, glabrous pedicels 0·5–1 mm. long. *Lower glume* 4–5 mm. long, 1·75 mm. wide at the base when flattened, sharply keeled, lanceolate-acute, scabrid on the keel, 1-nerved, straight or slightly curved on the back, translucent ; *upper glume* 5–6 mm. long, 2·5 mm. wide at the middle when flattened, narrowly ovate-elliptic-acute in shape, strongly 3-nerved, translucent, scabrid on the nerves, sparsely pilose on the side nerves or completely glabrous. *Lemma* 5·5–6 mm. long, 2·5 mm. wide, oblong-elliptic-acute, strongly keeled, 3-nerved, slightly tinged with purple to almost black, rarely pale-translucent, covered all over the dorsal surface with pale crisped hairs ; *palea* 4·5 mm. long, narrowly lanceolate, sharply 2-keeled around the two nerves, pilose on sides, keels, and between the keels with ascending hairs ; *stamens* 3 ; *anthers* yellow, 2·5–2·75 mm. long ; *styles* 2 ; *stigmas* 2, plumose ; *lodicules* 2, cuneate, truncate ; *rhachilla* glabrous, disarticulating above the glumes and between the florets. *Grain* 2·5 mm. long, cylindrical ; *hilum* basal, elliptical ; *embryo* about one third of the length of the grain.

Tibet : 5000 m., Jul. Sept. 1891, *Thorold* 120, " sandy soil in valleys ". Type in Kew Herb. ; Capt. Deasy's Expedition to Tibet 1896–97, *Arnold-Pike* s.n. ; Khambajong, 26 Jul. 1903, *Younghusband* 147.

India : Kashmir, Tsaka, Ladak, 4700 m., 18 Jul. 1931, *W. Koelz* 2365. Type of *Orinus arenicola* Hitchc.

NOTES ON DIMERIA R. BR.

N. L. Bor.

Eduard Hackel described a new species of *Dimeria*, which he called *D. leptorhachis* Hack., in De Candolle's *Monographiae Phanerogamarum*, *Andropogoneae*, **6,** 89 (1889). He divided the material upon which he based this species into two subspecies. Subspecies a. *genuina* is based upon two sheets of Thwaites', nos. 24 and 3261 from Ceylon. This subspecies

Hackel distinguishes as follows :—" The leaves are glabrous save for some fimbriae near the base*; racemes 6-10, somewhat laxly spiculate ; internodes of the rhachis half the length of the spikelets (3·5 mm. long), ciliate on the nodes ; pedicels ciliate on the outer margin ; spikelets 6 mm. long, bearded at the base with hairs longer than the callus, brownish. Lower glume long pilose above, scabrous on back and sides. Awn 9–10 mm. long, smooth on the column."

The other subspecies b. *velutina* is based upon a collection of Griffith's, which bears the Kew distribution number 6799. Hackel, loc. cit. 90 quotes this number as follows :—" Ind. Or (Bengalia v. Himalaya) Griffith 6799 ". The label on both the sheets which bear this number in the Kew Herbarium, gives the following details—" Herbarium of the late East India Company. No. 6799. East Himalaya. Herb. Griffith. Distributed at the Royal Gardens, Kew, 1863–64." This is obviously the reason why Hackel supposed that the plant came from Bengal or the Himalaya. It is far more likely, however, that Griffith collected this species during his travels in Burma, for it matches a gathering of Helfer's from Tenasserim down to the smallest detail. Hooker fil. has, in his own hand, crossed out " East Himalaya " and substituted " Tenasserim " in pencil on one of the sheets. It is known that Griffith did visit Tenasserim and nothing like subspecies b. *velutina* has ever been collected in India proper. Hackel's diagnosis of subspecies b. *velutina* is as follows :—

" Leaves velvety villous with the villae distichous on the median nerve of the lower surface. Racemes 3–5, rather long (12 cm.), laxly flowered ; rhachis of the racemes very glabrous ; internodes 5 mm. long, about a quarter shorter than the spikelets. Pedicels glabrous. Spikelets 7·5 mm. long, with a beard at the base which is shorter than the callus, dark brown. Lower glume glabrous above. Awn 12–14 mm. long, scabrid on the column." The racemes in this specimen are even longer than Hackel states, for they are about 16 cm. long.

These differences can be summarised in tabular form as follows :—

(a) *genuina*	(b) *velutina*
Leaves more or less villous.	Leaves covered with a dense coat of tubercle-based hairs.
Racemes 6–11, up to 12 cm. long.	Racemes 4–5, up to 16 cm. long.
Internodes of the rhachis 2·75 mm. long.	Internodes of the rhachis 4–5 mm. long.
Awn 9–10 mm. long.	Awn 12 mm. long.
Callus beard longer than the callus.	Callus beard shorter than the callus.
Spikelets 5·5–6 mm. long.	Spikelets 6–7 mm. long.

These two subspecies look very different from one another and in fact represent two distinct species. Apart from their morphological differences, they occupy different geographical regions.

When attempting to draw up a key to the species of *Dimeria* it was found quite impossible to select any trustworthy character or combination

*Actually the leaves are ± villous, N.L.B.

of characters whereby *D. gracilis* Nees could be separated from *Dimeria leptorhachis* Hack. subspecies *genuina* Hack*.

Hackel, loc. cit., gives full length descriptions of the two grasses and he, himself, provides at the head of each description, diagnostic features upon which he apparently relies to separate them. These are the shape of the base of the leaf and the presence of wax below the nodes. Taking the latter first : no wax can be made out below the nodes in either species. This is particularly puzzling since it is absent in the type specimen of *D. leptorhachis* Hack., the species on which it is supposed to occur. The shape of the base of the leaf is equally unsatisfactory. In *D. leptorhachis* Hack. the leaf-base is said to be narrowed to the sheath, while in *D. gracilis* Nees the leaf-base is said not to be so contracted. In point of fact, however, there is no difference whatever in the leaf-bases of both the species. If the descriptions of the two grasses are compared, it will be seen that any difference in the lengths of parts of the spikelet, number of racemes, and so forth, could easily be explained, and indeed, expected, as the normal variation within a species. I have therefore no hesitation in reducing Hackel's species as typified by his subspecies *genuina* to the synonymy of *D. gracilis* Nees ex Steud.

D. gracilis Nees is found in India and Ceylon, from altitudes as low as the Western Ghats in the Concan at 600 m. to the heights of Adam's Peak in Ceylon at 1,700 m.

A full description of *D. gracilis* Nees ex Steud. with its synomymy follows.

Dimeria gracilis *Nees ex Steud.* Syn. Pl. Glum. 413 (1854).

D. leptorhachis Hack. subspec. *genuina* Hack. in D.C. Monogr. Phan. **6,** 89 (1889).

D. pilosissima Thw., Enum. Pl. Zeyl. 369 (1864) non Trin.

D. laxiuscula Thw. ex Trim. in Journ. Bot. **23,** 272 (1885).

A perennial grass. Culms up to 85 cm. tall, slender, smooth and glabrous even on the nodes, striate, covered at the base with the bases of old sheaths which are hirsute, with whitish hairs. *Leaf-blades* linear, narrowed at the base to the sheath, tapering gradually to a very acuminate, stout point, absolutely smooth and glabrous or covered sparsely with whitish hairs, up to 25 cm. long, 7–8 mm. wide, usually flat, sometimes plicate, ascending not spreading ; *sheaths* tight, close, overlapping, smooth and glabrous except those at the base which are covered below with a covering of stiff whitish hairs, covering the nodes ; *ligule* very short, membranous, lacerate.

Inflorescence of a number (6–11) of racemes seated on a long-exserted, glabrous peduncle ; racemes up to 12 cm. long, usually much less, consisting of a filiform, tough rhachis bearing pedicelled spikelets, one to a node ; nodes of the raceme short about half the length of the pedicels, clavate, 2·75 mm. long, ciliate along the outer margin with hairs up to 2 mm. long, ciliate on the margin of the oblique articulation above ; rhachis tough, glabrous. *Spikelets* 5·5 to 6 mm. long, including a callus 0·5 mm. long, gaping at the mouth ; callus bearded with hairs which are

*Hook. f. had previously come to the same conclusion in Trim. Flor. Ceyl. **5,** 199 (1900).

longer than itself. *Lower glume* 5 to 5·5 mm. long, 1·2 mm. wide when flattened, chartaceous in texture, thinning out on the margins, oblong-acute with a very short mucro at the tip which is often bent backwards, covered all over the back with long white hairs ; *upper glume* 5–6 mm. long 1–1·5 mm. wide, oblong-acute with the tip drawn out into a reflexed mucro, coriaceous in texture becoming thin on the margins, somewhat keeled towards the apex and covered all over the back with fairly long white hairs. *Lower floret* empty ; *lemma* hyaline, 1·5–3 mm. long, bearing white hyaline hairs as long as itself on the margins; *palea* absent; *upper floret* ♀ ; *lemma* 4 mm. long, cleft at the tip into two acute or obtuse lobes, hyaline, linear-oblong in shape, with a few hairs at the top, awned in the cleft ; *palea* absent or a minute scale ; *awn* 9–10 mm. long, of which 4 mm. are twisted, brown column ; *stamens* 2 ; *anthers* 3 mm. long ; *styles* 2, short ; *stigmas* plumose, purple ; *lodicules* 2, small, cuneate.

Ceylon : Adam's Peak, *Thwaites* C.P. 24, 3261 .

Ind. Or. : Concan, *Woodrow*.

As *Dimeria leptorhachis* Hack. is typified by its subspecies *genuina*, and since this subspecies is sunk in synonymy under *D. gracilis* Nees, the remainder of the material included by Hackel in his concept of *D. leptorhachis*, i.e., subsp. *velutina* is left without a name.

Reference has been made earlier in this paper to the differences between what Hackel considered to be two subspecies of the same species. These differences may seem small but taken together they contrive to give each plant a distinctive facies. In addition to the morphological differences, however, there is the distribution to be considered. *D. gracilis* is confined to India and Ceylon, while subspecies b. *velutina* is (so far) only found in Tenasserim in Burma. It is proposed here to raise Hackel's *D. leptorhachis* subsp. *velutina* to specific rank and a description of it follows.

Dimeria velutina *Bor*, stat. nov. *D. gracili* Nees ex Steud. affinis sed ab ea foliorum laminis vaginisque dense villosis, articulis racemorum longioribus, racemis longioribus valde differt.

D. leptorhachis Hack. subspec. *velutina* Hack. in D.C. Monogr. Phan. **6,** 90 (1889).

A perennial grass, erect or slightly decumbent at the base, hirsute on the basal sheaths. *Culms* up to 60 cm. tall, covered with overlapping sheaths in the lower half, smooth and glabrous, terete, striate, upper half bare and exserted from the uppermost leaf-sheath. *Leaf-blades* up to 20 cm. long by 12 mm. broad, linear-acuminate, long tapering to a very slender but stout point, covered on both surfaces with an exceedingly thick coat of fine, white hairs arising mostly from rather small tubercle-bases, on the lower surface these hairs stand out at right angles to the midrib of the blade, smooth or most minutely scaberulous on the cartilaginous margins, mostly erect and not spreading ; *leaf-sheaths* tight, the older breaking away from the culm, striate on the back and sides, covered all over with a very dense, close, hairy covering of fine white hairs from tubercle-bases ; *ligule* membranaceous, convex upward, glabrous, 1–2 mm. long.

Inflorescence of 4–5 racemes up to 16 cm. long, consisting of a tough, filiform, glabrous rhachis with nodes 4–5 mm. long and spikelets seated on short glabrous pedicels at each node ; pedicels clavate, glabrous, 0·5 mm. long. Spikelets 6–7 mm. long (with a callus 0·5 mm. long), oblong in outline, slightly gaping ; callus 0·5 mm. long, smooth and glabrous, but bearded on the lower margins with hairs which are shorter than the callus : *lower glume* oblong-acute, chartaceous, 6·5 mm. long, 0·75 mm. wide, obscurely nerved, scabrid on the rounded, dorsal surface ; *upper glume* 6·5 mm. long, 1·0 mm. wide, strongly keeled, scabrid on the keel with a few hairs towards the top, scabrid on the sides, scarious on the margins, ciliate on the margins. *Lower floret* empty ; *lemma* a hyaline scale 4 mm. long, 0·5 mm. broad, rather firm along the middle line, ciliate on the margins towards the acute tip ; *upper floret* ♀ ; *lemma* 5 mm. long, 1·0 mm. wide, cleft at the tip into two acute lobes, awned in the cleft, smooth and glabrous ; *awn* 12 mm. long, of which half is brown twisted column ; *stamens* 2 ; *anthers* 3·5 mm. long ; *styles* 2, long ; *stigmas* plumose, purple ; *palea* absent or an insignificant, hyaline scale 2 mm. long ; *lodicules* 2, very small, cuneate.

Burma : Tenasserim ? *Griffith* 6799. Tenasserim, *Helfer*.

There are two sheets of each of these gatherings in the Herbarium at Kew. On the label of one of Griffith's sheets is the word 'Tenasserim' followed by a question-mark. All of these had been identified by General Munro as *Dimeria pilosissima* Trin. a species of which the correct name is *D. chloridiformis* (Gaud.) K. Schum. et Lautb. and which is a species confined to the eastern islands of Polynesia.

Bibliographical Note.

Hooker's Icones Plantarum, vol. 35 (ser. 5, Vol. 5), Part 4.—Owing to unavoidable delays in publication this was issued in December 1951, not 1950, as printed on the cover and title-page.

Wild Orchids of Britain*—This book forms a most valuable contribution to our knowledge of the wild orchids of Britain. It opens with a general account of the life history of the orchid plant including the germination, development of the seedling, early stages, the action of mycorhiza, saprophytic orchids and vegetative multiplication. This is followed by a chapter on the orchid flower in which its complicated structure is described in non-technical language and the range of variation and the types of abnormalities, are discussed. The reader then passes on to a very clear account of pollination and fertilisation, then to the distribution which is dealt with both from the geographical and ecological points of view.

The remainder of the book is devoted to the classification and a descriptive account of the orchid groups met with in the British Isles

*Wild Orchids of Britain : by V. S. Summerhayes. (New Naturalist Series) pp. xvii. +366. 61 col. and 39 uncol. pls., 19 text figs., 43 distrib. maps. London : Collins, 1951. Price 21/-.

such as the helleborines, twayblades, ladies tresses, habenarias, orchis proper and so on. There is an appendix giving an artificial key for the determination of species of British orchids, a glossary and a bibliography. The volume ends with a series of useful distribution maps and a very complete index.

The style of writing is fluent and the author, who has the happy faculty of being able to generalise while maintaining accuracy, has produced a very readable volume which will be welcomed by all who take an interest in our wild orchids. The book is well printed and is illustrated by 61 photographs in colour, in addittion to ohers in black and white, and figures in the text.

H. S. Marshall.

Arboreal Flora of Israel and Jordan*—Those familiar with the works of Eig and Zohary on the Palestine Flora and its geobotanical relationships will rightly anticipate in this publication by the surviving member of that partnership a wealth of detailed observation illuminated by wide scholarship and suggestive generalisations and hypotheses. Palestine, in proportion to its area, is exceptionally diverse ecologically, its great geological variety being matched by a range in rainfall of from c. 25 to c. 1000 mm. per annum, and, while mountains rising to over 1500 m. produce, as commonly happens, islands of a northern climate, the Dead Sea depression provides a unique island of tropical climate with outlying stations of such genera as *Acacia*, *Grewia*, *Cordia*, *Moringa* and *Ziziphus*. The vegetation of Palestine is also of especial interest because of the long history of its interaction with Man. Agriculture and written records are as old here as anywhere else on earth and here the age-long struggle between pastoral nomads and settled cultivators, between the goat and the tree, has been going on longer than anywhere else. Today intensive (and expensive) schemes for reafforestation, land reclamation, extension of cultivation and soil conservation offer all kinds of opportunities for studying the reaction of the vegetation to changing circumstances. Finally, as investigators of this classic and rapidly changing land, we have a galaxy of eminent scientists who bring the learning and vigour of Central Europe to the study of the ancient home of their race and who combine the passion of the patriot with the freshness of outlook of the foreigner. It is thus not surprising that every botanist will find something of interest in this small book ; nor that it raises more questions than it answers. It is to be hoped that this work, valuable as it is in itself, may be but a prodromus to a more exhaustive treatment. Perhaps the epochmaking flora by Tackholm and Drar now appearing in Egypt will invite emulation.

J. B. Gillett.

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*The Arboreal Flora of Israel and Transjordan and its Ecological and Phytogeographical Significance. By M. Zohary. pp. 59 and map. Imperial Forestry Institute, University of Oxford, Institute paper no. 26 (1951). Price 5/-.

AFRICAN ORCHIDS : XX*

V. S. Summerhayes.

The present paper consists mainly of miscellaneous contributions to the taxonomy and nomenclature of species from Tropical and South Africa and from the Madagascar region. It also includes descriptions of several new species belonging to various genera ; the type specimens of these are all in the Kew Herbarium.

Holothrix hispidula (*Linn. f.*) *Durand & Schinz*, Consp. Fl. Afr. **5,** 70 (1895).

Orchis hispidula Linn. f. Suppl. Plant. 401 (1781).

Holothrix squamulosa Lindl. in Hook. Comp. Bot. Mag. **2,** 206 (1836) ; Rolfe in Dyer, Fl. Cap. **5,** iii, 102 (1912).

A careful examination of all the relevant literature and synonymy shows that, assuming Rolfe's concept of this species to be correct, the correct name is as given above. The synonymy in Flora Capensis of this species and of that passing under the name of *Holothrix parvifolia* Lindl. is hopelessly confused, so that although *O. hispidula* Linn. f. is cited under one species, the combination *H. hispidula* (Linn. f.) Dur. & Schinz will be found under the other.

Diplacorchis engleriana (*Kraenzl.*) *Schltr.* in Beih. Bot. Centralbl. **38,** abt. 2, 129 (1921).

Brachycorythis crassicornis Kraenzl. in Vierteljahrsschr. Nat. Ges. Zürich, **74,** 103 (1929).

The material of *Dümmer* 5533 in the Kew Herbarium is clearly referable to *Diplacorchis engleriana*. It agrees also in most features with Kraenzlin's description of *Brachycorythis crassicornis* (based on the same gathering), though the flowers are slightly larger. The anther, however, is said by Kraenzlin to be reclinate, while there is no mention of the two upright plates so characteristic of *Diplacorchis*. In spite of these discrepancies, I have little doubt that the material described by Kraenzlin belongs to the same species as the duplicate of the same number at Kew. The paper containing the description of *B. crassicornis* contains numerous errors and it is clear that Kraenzlin at the time did not have access to any really representative collection of African orchids.

Cynorchis filiformis *Schltr.* in Fedde, Repert. Spec. Nov. Beih. **33,** 48 (1924).

C. hirtula H. Perrier in Arch. Bot. Caen, **5,** Bull. mens. 49 (1931) et in Humbert, Fl. Madag. Orch. **1,** 108 (1939).

Cynorchis papillosa (Ridl.) *Summerhayes*, comb. nov.

Habenaria papillosa Ridl. in Journ. Linn. Soc. Lond. Bot. **21,** 504 (1885).

Peristylus filiformis Kraenzl. in Abbandl. Nat. Ver. Bremen, **7,** 258 (1882).

Cynorchis filiformis (Kraenzl.) H. Perrier in Arch. Bot. Caen, **5,** Bull. mens. 48 (1931) et in Humbert, Fl. Madag. Orch. **1,** 102 (1939).

*Continued from K.B., 1949, 443.

Careful consideration of the above synonymy in relation to the International Rules of Nomenclature will show that the names adopted here are the correct names for the two species concerned, and not the names used by Perrier de la Bâthie (See references above). Although the epithet *filiformis* was used first of all for the second species, it had not been used *in the genus Cynorchis* at the time when Schlechter proposed the new species *C. filiformis*. Incidentally Schlechter did not include *Peristylus filiformis* Kraenzl. in *Cynorchis* at all but made it the type of his new genus *Helorchis*. The later combination *Cynorchis filiformis* (Kraenzl.) H. Perrier is therefore a later homonym and the next epithet *papillosa* must be used for the species concerned.

Habenaria chlorotica *Rchb. f.* in Flora, **48,** 178 (1865) ; Summerh. in Bot. Mus. Leafl. Harv. Univ. **10,** 259 (1942).

H. pertenuis Kraenzl. in Vierteljahrsschr. Nat. Ges. Zürich, **74,** 105 (1929).

Examination of the type material of Kraenzlin's species shows it to agree very closely with the widely ranging *H. chlorotica*. This latter species has been already recorded from north (Houtbosch) and south (Lydenburg) of the type locality (Shilouvane) of *H. pertenuis* and is clearly widely distributed in the eastern Transvaal.

Since I last wrote about this species (see reference above) it has been discovered in Sierra Leone and the eastern part of the Belgian Congo and no doubt occurs throughout the savanna regions of Africa.

Habenaria spiranthes *Rchb. f.* in Flora, **48,** 178 (1865).

H. filicornis (Thonn.) Lindl. Gen. & Sp. Orch. 318 (1835), non *Orchis filicornis* Linn. f.

Owing to the existence of the earlier *Orchis filicornis* Linn. f., *O. filicornis* Thonn. is a later homonym and consequently illegitimate, and this also applies to combinations based upon it. The correct name for the widely spread *Habenaria* which I have previously called *H. filicornis* (Thonn.) Lindl. (see Bot. Mus. Leafl. Harv. Univ. **10,** 259 : 1942) is therefore *H. spiranthes* Rchb. f.

Habenaria volkmanniae *Kraenzl.* in Vierteljahrsschr. Nat. Ges. Zürich, **74,** 105 (1929).

Examination of the type specimen of this species shows that it is quite abnormal in structure. The petals are reduced to ovate rather fleshy structures with a small pointed outgrowth at the base of the anterior margin suggesting an almost suppressed anterior lobe. Along the posterior margin of each petal there is a more or less well-developed anther loculus, containing in some flowers an imperfect pollinium. The lip is also clearly reduced, the middle lobe being very fleshy with a convex upper surface while the laterals are much shorter, very slender, almost hyaline and more or less curled up. Along each margin of the middle lobe in some flowers there is a narrow slit which suggests the incipient formation of yet two more anther loculi. I have seen similar anther formation on the petals and lip in other species of *Habenaria* in the same

general circle of affinity (sections *Bilabrellae*, *Cultratae* and *Ceratopetalae*). The trilobed dorsal sepal stressed by Kraenzlin is also clearly abnormal, and may represent some sort of compensation for the reduction in size of the petals. The column appears to be relatively normal though the usual close adnation of the anther canals and rostellum lobes is sometimes imperfect.

It is not possible to refer the specimen to any other known species nor is it quite certain to which of the above three sections the normal form belongs, though section *Cultratae* seems most likely. Further collection of *Habenarias* from the general region of Otavi is desirable in order to determine what normal species are present.

Bonatea insignis (*Schltr.*) *Summerhayes*, comb. nov.

Habenaria insignis Schltr. in Engl. Bot. Jahrb. **20,** Beibl. 1, 32 (1895).

It is clear that this species is better referred to *Bonatea*. It is very closely related to *B. polypodantha* (Rchb. f.) L. Bolus and may, when further material is available, prove to be merely a short-spurred variety of that species.

Bonatea stereophylla (Kraenzl.) Summerh. in Kew Bull. **1949,** 430. *Habenaria polychlamys* Schltr. in Engl. Bot. Jahrb. **53,** 508 (1915).

Examination of the type collection of Schlechter's species shows that it is identical with *Bonatea stereophylla* from the same general region.

The species is distinctive on account of the small extent to which the various floral parts (lip, stigmas, petal-lobes) are united, but the structure of the various parts is that of the genus *Bonatea*. In particular the rostellum and stigmas are quite characteristic. The tooth in the mouth of the spur, described and commented on by Schlechter, is even larger and more prominent than in any other species of the genus. The species is similar to *B. porrecta* (Bolus) Summerh. in the leaves dying away by the time the flowers are expanded.

When Cortesi (Ann. di Bot. Roma, **2,** 362–365 : 1905) described *Bonatea pirottae* he gave a short review of the genus, mentioning the species enumerated by Kraenzlin in his monograph (Orch. Gen. et Sp. **1,** 178–184 : 1897). Kraenzlin included them in *Habenaria* (sect. *Bonatea*) but Cortesi maintains *Bonatea* as a distinct genus. Although the combinations under *Bonatea* are not set out in the orthodox manner there seems little doubt that Cortesi looked upon these as the correct names for the species concerned.

Two of these combinations are new, though unfortunately, for the reasons mentioned above, they were overlooked when Index Kewensis was compiled. They are as follows :—

Bonatea saundersioides (Kraenzl. & Schltr.) Cortesi, l.c. 363, in obs. *B. arabica* (Deflers) Cortesi, l.c., in obs.

These two citations antedate the similar combinations made by Rolfe (Dyer, Fl. Cap. **5,** iii, 140 : 1912) and myself (Kew Bull. **1949,** 432) respectively.

Disa verdickii *De Wildem.* in Ann. Mus. Congo, sér. iv. **1,** 26 (1902).

When De Wildeman described this species he emphasised the point, which is incorporated in a key provided by him, that it differed from other allied species of Sect. *Calostachys* by the absence of an appendage to each of the petals ; these were said to be elliptical.

Recently I have been studying some material from Northern Rhodesia which agreed well with the description in most respects but differed in the petals having a long narrowly spathulate appendage. On examining the Type Specimen, kindly loaned by the authorities of the Brussels Botanic Gardens, I find that De Wildeman was in error in his description of the petals. These all possess a narrowly spathulate appendage, equal in length to, or perhaps somewhat longer than, the basal portion. This appendage is tucked into the folded back part of the intermediate sepal and was clearly overlooked by De Wildeman. The species may be distinguished from its allies by the purple flowers, and also by the proportions of the various floral parts.

Satyrium atherstonei *Rchb. f.* in Flora, **64,** 328 (1881).

S. occultum Rolfe in Dyer, Fl. Trop, Afr. **7,** 273 (1898).

S. nuttii Rolfe, l.c.

In a previous contribution in this series (Kew Bull. **1933,** 52) I reduced *S. zombense* Rolfe to *S. occultum* Rolfe. Further examination of the members of this group shows that *S. occultum* and *S. nuttii* Rolfe are conspecific with the South African *S. atherstonei* Rchb. f. On careful inspection of a number of flowers the supposed differences in the rostellum between *S. occultum* and *S. nuttii* are seen to be non-existent. In both species the rostellum is undivided but shortly 3-toothed at the apex, the two large viscidia lying in the sinuses between the teeth. *S. atherstonei* has exactly the same floral structure as both of the above, with the flowers about the same size as those in *S. nuttii* ; in the original specimens of *S. occultum* the flowers are somewhat larger. On the whole the flowers in the Tropical African specimens are larger than in those from South Africa, but there are many specimens at Kew with intermediate sized flowers.

The species is closely allied to *S. trinerve* Lindl., from Madagascar and was united with the latter by Bolus. The Madagascan species, however, is a more slender plant with narrower leaves, uniformly short spike and smaller flowers. *S. atherstonei* has been found throughout the greater part of the savanna regions of Tropical Africa, except Kenya Colony, and extends southwards through the Transvaal and Natal to the eastern part of the Cape Province.

Disperis egregia *Summerhayes*, sp. nov. ; a *D. kerstenii* Rchb. f. foliis sub-oppositis vel alternis, sepalis lateralibus dimidio inferiore inter se connatis, petalis basi subcordato-auriculatis, labello simplici, appendice decurvata carnosa dense papillosa facile distinguenda.

Herba terrestris, parva, usque ad 18 cm. alta, glaberrima ; tuber et radices non visae. *Caulis* erectus, 8–16·5 cm. altus, verosimiliter teres, dimidio inferiore 2-foliatus, apice circiter 3-florus. *Folia* alterna vel sub-

opposita, sessilia vel breviter petiolata, e basi vaginante ovata vel lanceolato-ovata, apice acuta vel breviter acuminata, basi subcordata caulem ± amplectentia, 2–5 cm. longa, 1·5–4 cm. lata, saturate viridia, siccitate textura tenuiter chartacea, basi septemnervia. *Inflorescentia* brevis, circiter 1 cm. longa ; bracteae foliis similes sed multo minores, ± recurvatae, usque ad 1 cm. longae. *Flores* horizontali, sed pedicellis (cum ovariis) erectis vel suberectis circiter 1·5 cm. longis, rosei. *Sepalum* intermedium cum petalis adnatum galeam apice rotundatam leviter incurvatam circiter 12 mm. longam formans, ligulatum, superne valde incurvatum, apice acutum ; sepala lateralia dimidio inferiore marginibus posticis connata, synsepalum anguste unguiculatum, superne subito dilatatum, apice truncatum vel excavatum angulis exteriorbus apiculatis, 10 mm. longum et 12·5 mm. latum formantia, sepala 3-nervia, margine postice sacco brevissimo obtuso instructa. *Petala* unilateraliter trilobata, circiter 11·5 mm. longa et 6 mm. lata ; lobus basalis auriculiformis, rotundatus ; lobus intermedius transverse ellipticus, circiter 8 mm. latus, a lobo basali sinu angustissimo sejunctus, plurinervius ; lobus apicalis galeae lateris partem formans, incurvatim anguste oblongo-ovatus, apice rotundatus. *Labellum* basi cum columna adnatum, anguste lineare, circiter 10·5 mm. longum, in galea absconditum, apice appendice carnosa tereti dependente curvata vel subfalcata basi rotundata breviter deorsum producta sursum sensim angustata dense papillosa circiter 4–5 mm. longa instructum. *Columna* circiter 3–4 mm. alta ; antherae loculi erecti, paralleli ; staminodia lata, bilobata ; rostelli lobus intermedius erectus, scutelliformis, apice breviter bilobatus, lobi laterales horizontali, circiter 1 cm. longi.

Tanganyika Territory. East Usambara Mts., Kihuhui track, Kwamkoro, 4 miles N.W. of Amani, 900 m. alt., on mossy rock face in rainforest, May 1941, *Moreau* 214 (type) ; Bomole, near Amani, 1050 m. alt., at base of rock in shade, June 1944, *Moreau* 214 A.

This remarkable species seems to have no near relative in the genus. It resembles superficially *D. kerstenii* Rchb. f., but is quite different in the lip structure, the shape of the petals and the partial union of the lateral sepals. The leaves are very similar to those of many species with strictly opposite leaves, but also are like a few alternate-leaved South African species. So far I have been unable to find any species with a lip at all similar. In the present species it consists of a long slender claw bearing at the apex a curved hanging carrot-shaped fleshy appendage which is closely covered all over with rather long papillae.

Malaxis katochilos (Schltr.) *Summerhayes*, comb. nov.

Microstylis katochilos Schltr. in Engl. Bot. Jahrb. **38,** 5 (1905).

This is quite distinct among African species, but is very similar in general appearance to *Orestias stelidostachya* (Rchb. f.) Summerh.

Malaxis schliebenii (*Mansfeld*) *Summerhayes*, comb. nov.

Microstylis schliebenii Mansfeld in Notizbl. Bot. Gart. Berlin, **11,** 808 (1933).

Didymoplexis africana *Summerhayes* sp. nov. ; inter species generis labello longiuscule unguiculato superne fere orbiculari infra apicem callo transverso undulato instructo satis distincta.

Herba terrestris, parva, aphylla, saprophytica, fere omnino glabra ; tuber horizontale, ± elongate fusiforme, usque ad 4 cm. longum et 7 mm. diametro, cicatricibus cataphyllorum annulatim notatum. *Scapus* ex apice tuberis exoriens, erectus, 8–21 cm. altus, saepissime ± flexuosus, basi radices tenues flexuosas emittens, apice laxiuscule vel densiuscule pluri- vel multiflorus ; pedunculus teres, 5–15 mm. longus, basi usque ad 3 mm. diametro, cataphyllis dissitis ± vaginantibus vel annulatis obtusis instructus ; rhachis pedunculo similis ; bracteae patentes vel ± recurvatae, ovatae vel triangulari-ovatae, 1–2 mm. longae. *Flores* patentes vel erecto-patentes, albidi vel cremei, ± roseo-tincti ; pedicellus cum ovario sub anthesi circiter 1 cm. longus. *Perianthii* segmenta, labello excluso, ± connata, tubum inferne sursum sensim dilatatum, superne bilabiatum formantia ; perianthii labium superius (sepalum intermedium et petala) erectum vel leviter incurvatum, trilobatum ; labium inferius (sepala lateralia) decurvatum, apice breviter bilobatum. *Sepalum* intermedium cum petalis per 7·5 mm. connatum, anguste subspathulato-ligulatum, apice obtusum vel leviter emarginatum, circiter 15 mm. longum, superne 3·5–4 mm. latum, trinervium ; sepala lateralia inter se per 7·5 mm. connata, cum petalis per 4·5 mm. connata, subspathulato-ligulata, apice obtusa apiculata inter se leviter conniventia, 10·5–12 mm. longa, 3·25–3·5 mm. lata, tri vel subquadrinervia ; omnia sepala extus in parte superiore verrucosa. *Petala* ex ungue cum sepalis adnato superne oblique subspathulata, apice obtusa, 10·5–12 mm. longa, 3·5–4·5 mm. lata, superne quadrinervia. *Labellum* liberum, ex ungue lineari sursum sensim dilatato flabellato-orbiculare, apice rotundatum, marginibus ± eroso-dentatis, in toto 10–11 mm. longum, superne 5·5 mm. latum ; lamina circiter 10-nervis, apice ± recurvata, infra apicem callo transverso carnoso undulato instructa, basi ligula retrorsa oblonga truncata apice denticulata. *Columna* recta, subteres, apice dilatata tridentata, basi callis duobus ellipsoideis instructa, circiter 10 mm. longa ; anthera applanato-hemisphaerica ; pollinia 4, ovoidea ; rostellum carnosum, reniformi-orbiculare, superne truncatum ; fovea stigmatica sub-elliptica. *Capsulae* anguste ellipsoideae vel fusiformi-ellipsoideae, 2–3 cm. longae, medio 1 cm. diametro ; pedicelli valde elongati, usque ad 25 cm. longi, subcarnosi.

Tanganyika Territory. East Usambara Mts., Amani, in forest, Dec. 1943, *Moreau* 269 A (type) ; Bomole, 1050 m. alt., in rain-forest shade, Nov. 1944, *Moreau* 269 B ; W. of Bomole, 990 m. alt., in dense shade of evergreen rain-forest, Jan. 1933, *Greenway* 3341 ; between Ngomeni and Ngambo, Nov. 1916, *Zimmermann* ; Ngomeni, in rain-forest, Jan. 1943, *Moreau* 269 ; between Kwamkoro and Kihuhui, 900 m. alt., in dense shade of evergeen rain-forest, Dec. 1936, *Greenway* 4787 ; Monga, 960 m. alt., in evergreen rain-forest, Dec. 1940, *Greenway* 6074.

Material of this species has been in the Kew Herbarium for a number of years, where it was thought to be referable to a new species of the West African genus *Auxopus*. The preservation of the flowers, however, was so poor that no useful decision could be taken. Recently I have had the opportunity of examining flowers in liquid preservative collected by Mr. and Mrs. Moreau. This shows that the species, instead of belonging to *Auxopus*, is the first known African representative of the allied Asiatic genus *Didymoplexis*. It shares with this genus the markedly bilabiate

perianth and the various calli on the lip, though these are quite different in detailed structure from those in any other species.

In *D. africana* the lip is more distinctly clawed than in most other species of the genus while the markedly undulate callus is transverse in position instead of longitudinal. At the apex of the claw is a reflexed or retrorsely placed ligule-like callus, very similar in position and character to that in other species.

The present species is known only from a circumscribed area around Amani in the East Usambara mountains. It grows among dead leaves on the floor of the evergreen rain-forest, always in deep shade. As in other species of the genus, and also in *Auxopus*, the fruiting pedicels elongate enormously, reaching a length of as much as 25 cm.

Three gatherings in the Brussels Herbarium, made by J. Gillet near Kisantu in the Bas Congo, are also clearly referable to the genus *Didymoplexis*. The flowers are similar in general appearance to those in *D. africana*, while the retrorse ligule at the apex of the lip-claw can be seen, but the preservation of the rest of the flower is not good enough to determine the specimens more accurately. They may represent a second African member of the genus, or they may be merely small-flowered specimens of *D. africana* itself.

Auxopus macranthus *Summerhayes*, sp. nov. ; ab *A. kamerunensi* Schltr. floribus majoribus, labello pro rata angustiore oblanceolato apice haud emarginato differt.—*A. kamerunensis* Schltr. var. *grandiflora* Summerh. in Kew Bull. **1936,** 222.

Herba terrestris, aphylla, saprophytica, glaberrima ; tuber non visum. *Scapus* ex apice tuberis exoriens, erectus, gracilis, 11–30 cm. altus, apice dense vel laxiuscule pluri- vel multiflorus ; pedunculus teres, ± flexuosus, 7–25 cm. longus, cataphyllis paucis vaginantibus arctis 1–3 mm. longis instructus ; rhachis gracilis, leviter flexuosa, 1·5–8 cm. longa ; bracteae patentes, lanceolatae, acuminatae, 1–3 cm. longae. *Flores* erecto-patentes, ochrei vel brunnei ; pedicellus cum ovario sub anthesi circiter 5 mm. longus. *Perianthium* ± tubulosum, segmentis (labello excluso) inferne inter se connatis, obscure bilabiatum. *Sepalum* intermedium lineari-ligulatum, apice subacutum, inferne cum petalis per 2·5–3·5 mm. connatum, 5·5–7·5 mm. longum, 0·5–0·7 mm. latum, uninervium ; sepala lateralia fere usque ad apicem inter se connata, synsepalum subspathulato-oblanceolatum, apice breviter sub-acute bifidum, basi subsacculato-dilatatum, 6–7 mm. longum, superne 1·6–2·2 mm. latum, 6-nervium formantia, dimidio inferiore cum petalis connata. *Petala* inferne cum sepalis connata, anguste oblanceolato-ligulata, apice ± acuta, 5·75–6·25 mm. longa, 0·6–0·9 mm. lata, uninervia. *Labellum* liberum, e basi angusta sensim dilatatum, oblanceolatum, apice obtusum vel rotundato-obtusum haud emarginatum, 5·5–6·25 mm. longum, 1–1·4 mm. latum, trinervium, ecallosum. *Columna* fere recta, subteres, apice leviter dilatata truncata, 5–5·5 mm. longa ; androclinium leviter excavatum ; anthera ± hemisphaerica, apice vix producta ; rostellum vix productum, obtusum ; fovea stigmatica fere orbicularis. *Capsulae* anguste ellipsoideae, 12–15 mm. longae, circiter 5 mm. diametro, perianthio emarcido coronatae ; pedicellus ± elongatus, usque ad 6 cm. longus.

Ivory Coast. Makougnié railway station, just S. of Agboville, Jan. 1907, *Chevalier* 17025.

Nigeria. Benin, Okomu Forest Reserve, compartment 70, in high forest, Jan. 1948, *Brenan & Jones* 8777 (type) ; same locality, boundary of compartments 86 and 69, *Brenan* 8535 A (in fruit).

Belgian Congo. Sankuru River, in forest, July 1903, *Luja* 27.

Uganda. Gaba, S.E. of Kampala, 1200 m. alt., in forest, Nov. 1915, *Dümmer* 2670.

This species is very similar in most respects to *A. kamerunensis* Schltr., but has considerably larger flowers on a longer and more richly flowered rhachis. The lip is quite entire at the end and usually bluntly pointed, instead of more or less emarginate as in the other species. The species is clearly widespread in the equatorial African forest region.

There are two gatherings in the Brussels herbarium (*Bequaert* 2661 and *Louis* 7775) which may represent a distinct species allied to *A. macranthus*. In neither case is the preservation adequate for proper description.

Auxopus seems to be sufficiently distinguished from *Didymoplexis* by the scarcely 2-lipped perianth and the entire ecallose lip, but the two genera are undoubtedly closely allied.

Liparis caespitosa (*Thou.*) *Lindl.* in Edwards, Bot. Reg. **11,** sub. t. 882 (1825).

The discovery of this Mascarene and Asiatic species in a number of widely separated localities in East Africa makes an important addition to the African species of the genus. *L. caespitosa* is the first representative in Africa of the section *Coriifoliae*, all the previously known species belonging to sect. *Mollifoliae*. It is characterised by the possession of distinct pseudobulbs, the leaves being articulated at their insertion on the bulb and falling away to leave a clean scar.

I have now seen material of *L. caespitosa* from three localities in Uganda, in Kigezi, Toro and Mengo districts respectively, and from two places in northern Tanganyika. The species was collected by Braun at Bomole near Amani many years ago, but the specimen (a small one) has remained undetermined until recently. All the other specimens have been collected during the last ten years. From the habitats there seems little doubt that it is native in Africa. The leaves in the African specimens have rather more parallel sides than those of Asiatic plants but I can see no other differences.

Liparis neglecta *Schltr.* in Engl. Bot. Jahrb. **53,** 561 (1915).

Commenting on this species, following the original description, Schlechter states that it obviously includes the plants from Tropical Africa which had previously been referred to *L. bowkeri* Harv. (see Fl. Trop. Afr. **7,** 21 : 1897). The only difference he mentions between his new species and *L. bowkeri*, however, is in the lip which he says is quite a different shape, without giving any further details.

Careful examination of all the available material from both Tropical and South Africa confirms that there are two distinct species. The lip in

L. neglecta tends to be broader near the base and is somewhat broader altogether than in *L. bowkeri*, in which the middle is usually the widest part. A better distinction is in the relative lengths of the lateral sepals and the lip. In *L. neglecta* the lateral sepals vary from 1·13 to 1·27 times the length of the lip, whereas the corresponding figures for *L. bowkeri* are from 1·33 to 1·46, that is, the sepals are from one third to one half longer than the lip. These differences are quite evident at sight and give the flowers in the two species different facies.

It is interesting to note that material collected by Schlechter in the Houtbosch Mountains in the Transvaal are clearly referable to *L. neglecta* and not to the South African species. The former species extends from Uganda and Kenya in the north southwards to the Transvaal. *L. bowkeri* is restricted to the Cape Province and Natal, judging by the specimens which I have seen, but it may yet be found in the southern Transvaal.

Bulbophyllum colubrinum (Rchb. f.) Rchb. f. in Walp. Ann. **6,** 257 (1861).

Megaclinium colubrinum Rchb. f. in Bonplandia, **3,** 223 (1855).

Bulbophyllum inaequale Rchb. f. in Flora, **69,** 553 (1886), non (Bl.) Lindl.

Megaclinium imschootianum Rolfe in Kew Bull. **1895,** 8.

Bulbophyllum imschootianum (Rolfe) De Wildem. Pl. Bequaert. **1,**86 (1921).

Examination of the type specimens of the above species shows that these are conspecific. *B. colubrinum* may easily be recognised by the 1-leaved pseudobulbs, the suddenly caudate-acuminate sepals, the very fleshy lip and the broad rounded wings to the column. *B. imschootianum* is distinguished from *B. colubrinum* by Rolfe (Dyer, Fl. Trop. Afr. **7,** 36 : 1897) by the lip being said to be denticulate at the base instead of entire. Examination of a number of specimens shows that the development of these teeth is very variable from one plant to another, but some indication of them may be seen in every specimen. In any case the denticulations are quite different from the pectinate basal part of the lip in some allied species of *Bulbophyllum* (e.g. *B. maximum* Lindl. and *B. imbricatum* Lindl.) ; the key in the Flora of West Tropical Africa (**2,** 433 : 1936) is therefore misleading, since it states under *B. imschootianum* " lip pectinate at the base " which is not correct. Actually the teeth are not borne on the margins of the lip as in the other species mentioned, but along a pair of very low ridges near the upper part of the fleshy lip.

Bulbophyllum flavidum *Lindl.* in Edw. Bot. Reg. **26,** misc. 83 (1840).

B. gabonis Linden & Rchb. f. in Flora, **48,** 185 (1865).

On examination of the type specimen of *B. gabonis* Lind. & Rchb. f. in the Reichenbach Herbarium I can see no differences between this and the widely spread *B. flavidum* Lindl.

Rolfe separates these two species in his key in the Flora of Tropical Africa (**7,** 23–24 : 1897) on the lip, which is said to be entire or nearly so in *B. flavidum*, and trilobed in *B. gabonis*. In this he has been misled by Reichenbach's description of the lip in the latter species. In neither type

specimen is the lip really trilobed. On flattening out the lip appears to be obscurely so in *both*, whereas in its natural position it is seen to be entire.

Bulbophyllum lupulinum *Lindl.* in Journ. Linn. Soc. Lond. Bot. **6,** 126 (1862).

B. ituriense De Wildem. in Rev. Zool. Afr. **9,** Suppl. Bot. 29 (1921).

Comparison of the type specimens of the above, together with other gatherings, shows that they are conspecific. Although De Wildeman mentions no specific differences in his original account of *B. ituriense*, it may be assumed that he separated his species from *B. lupulinum* on the sizes of the vegetative parts. Material from other sources include all intermediates between the types in these respects, while the flowers in the two " species " are identical. Incidentally, the pseudobulbs in the type of *B. ituriense* are 2·5–4·5 cm. long, not 25–45 cm. as given in the description !

The discovery of the identity of these two species extends considerably the distribution of *B. lupulinum*. This was previously known only from West Africa, extending from Sierra Leone to the region of Yaoundé in the French Cameroons. Presumably the species extends from here right across the Congo Basin to the Ituri forest region where Bequaert collected it.

Bulbophyllum melanorrhachis (*Rchb. f.*) *Rchb. f. ex De Wildem.* Pl. Bequaert. **1,** 93 (1921).

Megaclinium melanorrhachis Rchb. f. in Gard. Chron. **4,** 162 (1875).

The name *Bulbophyllum melanorrhachis* first appeared in print as a synonym at the end of Reichenbach's description of his *Megaclinium melanorrhachis*, and was therefore invalid. It was again published as a synonym by Rolfe in the Flora of Tropical Africa (**7,** 42 : 1897). The first valid publication of the name appears to be in De Wildeman's account of the African species of *Bulbophyllum* in the first volume of Plantae Bequaertianae, and the name should therefore be cited from that place.

Bulbophyllum metonymon *Summerhayes*, nom. nov.

B. zarataananae Schltr. in Fedde, Repert. Beih. **33,** 246 (1925), non Schltr. l.c. 192 (1924).

B. schlechteri Kraenzl. in Fedde, Repert. **25,** 56 (1928), non De Wildem.

B. schlechterii H. Perrier, Cat. Pl. Madag. Orch. 39 (1930).

The above synonymy indicates a measure of confusion which has rarely been paralleled in nomenclature. This confusion started when Schlechter gave two different species of *Bulbophyllum*, one from West and the other from East Africa, the same name *B. winkleri* in 1906 and 1914 respectively. De Wildeman quite properly renamed the second of these *B. schlechteri* in 1921. Later, in his account of Perrier de la Bâthie's Madagascar orchid collections Schlechter gave the name *B. zarataananae* to two distinct species in different parts of his paper. Kraenzlin pointed this out in 1928, but unfortunately renamed the second of these species

B. schlechteri, thus producing another later homonym ! Two years later Perrier de la Bâthie, apparently unaware of Kraenzlin's change of the name, again renamed Schlechter's second *B. zaratananae* as *B. schlechterii*, a name which he maintains in his account of the orchids in the Flore de Madagascar.

It is quite clear that the Madagascan plant cannot bear the name *B. schlechteri*, however the trivial is spelt, as that is correctly applied to the East African plant originally named after Winkler. I am therefore providing a new epithet, which indicates the various changes in the name, for the second *B. zaratananae* described by Schlechter.

Bulbophyllum nigripetalum *Rolfe* in Kew Bull. **1891,** 197.

This species was originally described from a cultivated plant, said to have come from West Africa. For some time I have felt doubtful as to whether this is the native country as no one has found the species growing anywhere in Africa and in floral structure it is not related to any African species.

Further investigation has shown that it is really a native of western China and may also occur in the adjoining regions of Burma and Siam. There is a specimen in the Kew Herbarium collected by Augustine Henry in Yunnan (No. 13055) which agrees almost perfectly in floral structure with the type specimen of *B. nigripetalum.* Furthermore there are several other species in this general region which are obviously closely related to our species, namely, *B. nigrescens* Rolfe from Burma and Siam and *B. secundum* Hook f. which also occurs in north-eastern India.

B. nigripetalum must therefore be removed from the list of African orchids. From the description of *B. inopinatum* W. W. Sm., also based on a cultivated plant of supposed African origin, it seems that this species is allied to *B. nigripetalum* and may also really be a native of Asia.

Bulbophyllum oreonastes *Rchb. f.* Otia Bot. Hamburg. 118 (1881).

B. melinostachyum Schltr. in Engl. Bot. Jahrb. **26,** 342 (1899).

Examination of the type collection of Schlechter's species shows that it is conspecific with the widely ranging *B. oreonastes* which is known from several places in Rhodesia.

Bulbophyllum pipio *Rchb. f.* in Linnaea, **41,** 92 (1877).

B. milesii Summerh. in Kew Bull. **1935,** 200 et in Hutch. & Dalz. Fl. West Trop. Afr. , 439 (1936).

Comparison of the type specimens of the above two species shows that they are identical. The species has now been found in Sierra Leone, the Gold Coast and the French Cameroons and probably also occurs in the intervening countries. It may be distinguished by the small 1-leaved pseudobulbs, narrow leaves and short few-flowered inflorescences. The upper surface and margins of the lip are papillose.

Bulbophyllum pogonochilum *Summerhayes*, nom. nov.

B. comosum H. Perrier in Humbert, Not. Syst. **6,** 94 (1937), non Collett & Hemsl.

The prior use of the epithet *comosum* for an Indian plant makes it necessary to provide a new one for the Madagascan species. The name refers to the long beard in the upper part of the lip.

Eulophia compta *Summerhayes*, nom. nov.

Lissochilus elegantulus Schltr. in Fries, Wiss. Ergebn. Schwed. Rhod.-Kongo-Exped. 1911–12, **1,** Bot. 244 (1916).

Owing to the existence of *Eulophia elegantula* Rolfe, a South African species, the trivial *elegantula* cannot be used in *Eulophia* for Schlechter's species. I have therefore provided a new trivial, as the species appears to be distinct from any others in the genus. It is a small-flowered member of the group to which *E. orthoplectron* (Rchb. f.) Summerh. belongs, and is clearly closely related to *E. schweinfurthii* Kraenzl.

Jumellea jumelleana (*Schltr.*) *Summerhayes*, comb. nov.

Angraecum jumelleanum Schltr. in Ann. Mus. Col. Marseille, sér. 3, **1,** 194, t. XXIV, fig. 1–8 (1913).

Jumellea henryi Schltr. in Beih. Bot. Centralbl. **33,** ii. 429 (1915) ; Perrier de la Bâthie in Humbert, Fl. Madag. Orchid. **2,** 184 (1941).

When Schlechter transferred his *Angraecum jumelleanum* to the genus *Jumellea* he adopted the new epithet *henryi*, presumably because he thought that otherwise a tautonym would be produced. In this he was followed by Perrier de la Bâthie in his treatment of the orchids of Madagascar. The combination *Jumellea jumelleana*, however, is not a tautonym as defined in Article 68 of the International Rules of Nomenclature, and is therefore the correct name for the species in the genus *Jumellea*.

Jumellea triquetra (*Thouars*) *Schltr.* in Beih. Bot. Centralbl. **33,** ii. 430 (1915).

Angraecum triquetrum Thouars, Orch. Iles Austr.-Afr. t. 49 (1822), quoad spec. florif. tantum.

? *A. neglectum* Frapp. ex. Cordem. Fl. Ile Réunion, 202 (1895).

? *Jumellea neglecta* (Frapp. ex Cordem.) Schltr. l.c. 429 (1915).

I find myself quite unable to agree with Perrier de la Bâthie's interpretation and typification of Thouars' *Angraecum triquetrum*. Clearly the epithet *triquetrum* is derived from the transverse section of the fruit and according to Perrier the two plants (flowering and fruiting) figured in Thouars' plate belong to different genera. The description accompanying the plate is in the form of a key with added characters and reads, when pieced together, " Fleurs solitaires. Eperon plus court que l'ovaire. Fleur ouverte. Labelle en cuiller, cariné. Tiges 3 pouces de long. Feuilles rapprochées, rubanées, bilobées, 4 pouces de long. Petale blanche." It will be noted that nothing is said about the fruit at all and clearly Thouars had in mind primarily a flowering plant. Several cases have been published illustrating the point that in a mixture the specimen from which the epithet was derived is not necessarily the type of a new species, but, on the other hand, the description is all important.

I think therefore there can be no doubt that the type of Thouars' species is the flowering specimen shown in the plate (t. 49). Schlechter's original combination, which does not mention the two different plants, is consequently also based on the type of *Angraecum triquetrum*, that is, on the flowering plant. His attempt in his later revision of the genus (Beih. Bot. Centralbl. **36,** ii. 155 : 1918) to associate the name *Jumellea triquetra* with the fruiting specimen, rather than with the flowering one, may be looked upon as the selection of a lectotype. On the other hand, this second combination, made, it should be pointed out, without any reference to the first, can also be considered merely as a later homonym, based on a different type !

Since the identification of the fruiting specimen is, to say the least of it, extremely doubtful, Schlechter and Perrier disagreeing with respect to the *genus* to which it should be referred, it seems in any case undesirable to attach the well-known epithet *triquetrum* to it.

Angraecum tenuipes *Summerhayes*, nom. nov.

A. ischnopus Schltr. in Beih. Bot. Centralbl. **34,** ii. 336 (1916), non *A. ischnopus* Schltr. (1905).

The name *Angraecum ischnopus* was originally used for a West African species now referred to *Angraecopsis*. The name, however, cannot be used for the Madagascan species which Schlechter later described, so I have provided an alternative name for this latter species. Both names refer to the very slender almost thread-like stalks of the flowers.

Diaphananthe curvata (*Rolfe*) *Summerhayes* in Hutch. & Dalz. Fl. West Trop. Afr. **2,** 456 (1936).

Mystacidium curvatum Rolfe in Dyer, Fl. Trop, Afr. **7,** 174 (1897).

Angraecum filipes Schltr. in Westafr. Kautsch.-Exped. 284 (1900), nomen, et in Engl. Bot. Jahrb. **38,** 22 (1905).

Examination of an iso-type specimen of Schlechter's species (*Schlechter* 12757) in the Brussels Herbarium and of the original description, indicates clearly that the above two species are conspecific. Most of Schlechter's differential characters are either non-existent or else are merely matters of degree and of no real significance. The only flower on the Brussels material has a well-developed spur 12 mm. in length, which measurement is at variance with Schlechter's own figures. Otherwise the specimen fits his description perfectly. The lip shows clearly the semi-circular rim-like callus in front of the spur mouth, a feature characteristic of *D. curvatum*. In his treatment of the Angraecoid orchids (Beih. Bot. Centralbl. **36,** ii. 122 : 1918) Schlechter placed *A. filipes* in his section *Rangaeris* of the genus *Aërangis* but this is clearly not its correct position.

This reduction extends the distribution of the species to the Cameroons ; it was previously known from Sierra Leone, Ivory Coast, Gold Coast and southern Nigeria.

Chamaeangis (§**Eu-chamaeangis**) **orientalis** *Summerhayes*, sp. nov. ; a *C. odoratissima* (Rchb. f.) Schltr. cauli pro rata brevi, foliis magis

carnosis angustioribus apice acutis, floribus majoribus, calcari duplo longiore, a *C. vesicata* (Lindl.) Schltr. floribus saepissime ternatis, perianthii segmentis obtusis, labello multo latiore apice obtusissimo, calcari dimidio apicali modice inflato tantum, ab utraque polliniorum stipitibus inter se adhaerentibus facile distinguitur.

Herba epiphytica radicibus exceptis glaberrima ; caulis modice elongatus, usque ad 12 cm. longus, circiter 5 mm. diametro, inferne radices flexuosas ramosas pubescentes griseas vel brunneo-griseas emittens, vaginis foliorum delapsorum fere omnino vestitus, superne subdense foliatus. *Folia* patentia vel saepius ± recurvata ; vagina circiter 1 cm. longa, longitudinaliter pluri-costata ; lamina ligulata, ± curvata vel falcata, plana vel ± V-formis, basi haud angustata, apice valde inaequaliter bilobulata, lobulo longiore usque ad 1·5 cm. longo obtuso breviore brevissimo vel fere nullo, tota 8–25 cm. longa, 7–17 mm. lata, valde carnosa. *Inflorescentiae* ex axillis foliorum vel foliorum delapsorum exorientes, saepissime solitares, erectae, patentes vel dependentes, usque ad 30 cm. longae, subdense vel dense multiflorae ; pedunculus crassiusculus, 5–9 cm. longus, basi 2–4 mm. diametro, vaginis pluribus laxis obtusis superioribus interdum 2–4-dentatis 2–7 mm. longis instructus, teres ; rhachis teres ; bracteae ochreatae, integrae vel 2–4-dentatae, brevissimae. *Flores* gemini ad quaternati, patentes, brunneo-flavidi, ochracei vel salmonei, fragrantes ; pedicellus cum ovario 3–5 mm. longus. *Sepalum* intermedium elliptico-ovatum, apice subacutum vel obtusum, 3–4 mm. longum, 1·75–2·5 mm. latum, trinervium vel sub-quinquenervium ; sepala lateralia oblique elliptico-oblonga, basi margine antico breviter auriculata, apice subacuta vel obtusa, 3–4 mm. longa, 1·6–2·4 mm. lata, trinervia. *Petala* oblique triangulari-ovata, apice saepissime acuta, 2·6–3·5 mm. longa, 1·4–2 mm. lata, trinervia ; tepala omnia ± recurvata. *Labellum* subcarnosum, patens, late ovatum vel elliptico-ovatum, basi subcordatum, apice leviter recurvatum, obtusum, 3·2–3·5 mm. longum, 2–3 mm. latum, medio leviter concavum, marginibus leviter recurvatis, plurinervium ; calcar ex ore angusto cylindricum, dimidio apicali paulo clavato-inflatum, leviter curvatum vel fere rectum, 15–20 mm. longum, prope apicem circiter 1·25 mm. diametro. *Columna* crassa, subteres, apice truncata, 0·75–1·25 mm. longa ; androclinium leviter excavatum ; anthera hemisphaerica, antice in appendice triangulari producta ; pollinia sphaeroidea vel ovoideo-sphaeroidea, circiter 0·5 mm. diametro, stipitibus linearibus apice leviter dilatatis per totam longitudinem inter se adhaerentibus circiter 0·8 mm. longis, viscidio communi anguste elliptico-ligulato utroque angustato 0·75 mm. longo pallide viridi ; rostellum ornithorrhynchum, deorsum productum, viscidio amoto fere omnino bifidum ; fovea stigmatica transverse elliptica ; ovarium levissime 6-sulcatum. *Capsulae* curvatim ellipsoideae, circiter 1 cm. longae et 4 mm. diametro.

Belgian Congo. Ruwenzori, Lanuri, 1900 m. alt., May 25th 1914, *Bequaert* 4407.

Uganda. Mt. Elgon, 1500–1800 m. alt., May 10th 1924, *Snowden* 880.

Kenya Colony. Mt. Elgon, Suam valley, 2100 m. alt., in forest, Feb. 1934, *Tweedie* 196 ; same locality, March 1936, *Tweedie* 321 (in

fruit) ; Sosian River, 1950 m. alt., in woods, Aug. 1939, *Tweedie* 482 ; same locality, 2100 m. alt., in forest, March 1941, *Tweedie* 559 ; Nanyuki, W. side of Mt. Kenya, Sept. 1943, *Copley* 33 ; above Nanyuki, 2280 m. alt., in forest, June 19th 1943, *Moreau* 676 ; Chyulu Hills, N. slope, 1350–1560 m. alt., on exposed trees in grassland, April 19th 1938, *Bally* 196 (Cornydon Mus. no. 7076) ; Chyulu Hills, April 1938, *Cunningham–van Someren* 19 (type).

Tanganyika Territory. Mt. Meru, 1500–2400 m. alt., at lower edge of and outside forest, April 21st 1940, *Vaughan* 3031 ; Moshi, Weru-weru Gorge, 1380 m. alt., coll. V. Harris, cult. and flowered Amani, March 14th 1942, *Moreau* 140 ; same locality, 1350 m. alt., July 20th 1943, *Moreau* 608.

Clearly a widely spread plant in East Africa in the lower part of the forest belt or on isolated trees just below. It resembles *C. odoratissima* (Rchb. f.) Schltr. in general floral features, especially the obtuse perianth and whorled flowers, but these are distinctly larger, differently coloured and have a much longer spur. The leaves in *C. odoratissima* are, moreover, much broader and bluntly bilobed at the apex. In *E. vesicata* (Lindl.) Schltr. which has similar narrow fleshy acute leaves, the flowers are usually in pairs, though rarely they may be ternate, the perianth members are sharply acute, while the spur is strongly inflated to form a swollen vesicular apex.

A striking feature of *C. orientalis* will be found in the pollinia. In other species of sect. *Eu-chamaeangis* the stipites are quite distinct though attached to a common viscidium. In the present species they adhere to one another throughout their length though the line of division can usually be seen in material preserved in liquid. In other respects the species falls naturally into sect. *Eu-chamaeangis* and is quite unlike the species of sect. *Microterangis* in which there is a common stipes to the two pollinia.

Ancistrorhynchus cephalotes (*Rchb. f.*) *Summerh.* in Bot. Mus. Leafl. Harv. Univ. **11,** 206 (1944).

A. glomeratus (Ridl.) Summerh. l.c. 208.

In my revision of the genus *Ancistrorhynchus* (see above reference) I suggested that these two species might prove to be conspecific when it was possible to see the type specimen of the former. On examination of this specimen in the Reichenbach Herbarium it is evident that this suggestion is correct and I have therefore made the above reduction of *A. glomeratus*. The original material of *A. cephalotes* agrees in every respect, both as regards vegetative and floral characters, with the specimens I had previously referred to *A. glomeratus* including, of course, the type specimen of the latter species.

Researches on Fungi*—It was widely known among mycologists that the late Professor Buller had not intended his notable series of ' Researches on Fungi ' to terminate with volume 6. Unfortunately the outbreak of

*Researches on Fungi. Volume VII. The sexual process in the Uredinales. A. H. R. Buller xx - 458 pp. $13.50. University of Toronto Press.

world war 2 and the author's premature death in 1944 delayed the appearance of volume 7 so long that it was almost given up for lost. It seems that they have in fact destroyed all hope of volume 8 which was left in too fragmentary a state to warrant publication. Professor Buller's unpublished manuscripts were bequeathed to the Royal Botanic Garden Kew, and it is by permission of the Director that volume 7, which was almost ready for the press when its author died, has now been published by the Royal Society of Canada. It has been handsomely produced in the same format and the familiar green binding of the previous volumes and is illustrated with the beautiful line drawings and carefully selected photographs one learned to associate with Professor Buller's work.

The present book is devoted entirely to a detailed discussion of the sexual process in the rust fungi. It is thus more of a review of literature and less an account of original research than its predecessors. After describing the earlier erroneous ideas of the function of rust pycnidiospores the author gives us a detailed account of the discoveries by Craigie and his associates at Winnipeg which finally disclosed their place in the life history. Professor Buller's earlier work on sexuality in basidiomycetes naturally led him next to institute a critical comparison of this process with the newly revealed phenomena in the rusts (Chapter 7) and to criticize the imperfect or erroneous conclusions drawn by cytologists from studies on microtome sections of fixed and stained material only. (Chapter 8). There follow chapters devoted to the life histories of *Cronartium ribicola*, *Puccinia suaveolens* and species of *Gymnosporangium*. The final short twelfth chapter is occupied by speculations on the contemporaneous evolution of insects and rust fungi.

The long delay in publication makes the book somewhat of a period piece. Indeed those of us who remember the excitement raised by Craigie's brilliantly simple but epochmaking discoveries may even be ungracious enough to find this prolix version of a twice-told tale somewhat tedious. But the university student of today, to whom the story is new, could not discover it with a better guide and it may well be that as a textbook this final volume may prove the most valuable of the series.

Of interest to specialists is the discussion of the name of the rust on the common field thistle, which Professor Buller shows should be *Puccinia suaveolens* (Pers.) Rostr. instead of the commonly accepted *P. obtegens* (Link) Tul. Characteristically thorough and helpful, too, is his study of the origin and derivation of the terms 'haploid ' and ' diploid ', which should be read not merely by mycologists but by cytologists and geneticists as well. Indeed it appears that lexicographers too have been capable of errors in this regard.

R. W. G. Dennis.

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CORRIGENDUM

In *Kew Bull. 1951*, pt. 3 (1952), p. 341, last line but one:—

For τριφύης *read* τριφύης
For striplici *read* triplicis.

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